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Forthcoming Events.

OCTOBER 16.
British Foundrymen's Association (London Branch).—Presidential Address by J. Ellis; followed by lantern lecture by D. Gordon.
OCTOBER 19.
Institute of Marine Engineers.—"Terrestrial Magnetism," by A. N. Somerscales.

NOTES AND COMMENTS.

War and its Industrial Aspects.

In our last issue we commented on the openings for British trade in neutral markets, resulting from the conduct of Germany in precipitating the present conflict in Europe. The possibilities set forth are, of course, rather questions for the future than projects for immediate participation—at least, until the re-establishment of international credit. But it is nevertheless advisable to keep certain commercial and industrial factors before our eyes, for in the immediate circumstances there is a likelihood of unconsciously assuming the attitude that nothing but the successful prosecution of military operations is worth consideration. We must bear in mind the important fact that military operations are only half a war. The success of any campaign in the ultimate is largely dependent upon the power behind, and that power is undoubtedly, under modern conditions, the commercial and industrial stability of the nation participating in the war. It is gratifying to note that British industries have so far stood the test very well. Viewed dispassionately, it must be admitted that after all war is only an incident, no matter how serious, expensive and protracted it may be, and the present conflict would be only half won, even were our arms absolutely successful, were it found that the industry and commerce of the nation had been seriously crippled. (In passing it would appear that this is likely to be the case with the industries of both Germany and Austria.) The nation's life is dependent upon the systematic conduct of its industrial affairs and the maintenance of its economic stability, and at times like the present crisis it is not only judicious but imperative to consider in what way the dislocation and disorganisation occasioned by the war may be counterbalanced. Whatever the result, the cost of the war and its effects must be paid, and it is for the nation to rise to the occasion and face the problem in such a manner that the attainment of our international objective may be accompanied by a firmer, more solid and substantial internal industrial position. The first essential is, naturally, to meet the Government's demands for men; the next is to ensure that the meeting of those demands does not too seriously disorganise and disturb the industries which are supplying the means for conducting the military operations.

As stated, whatever the ultimate result of the conflict of nations may be (and there is no reason to anticipate one discreditable to our own arms or those of our allies), it is certain the cost will lay as a serious burden on each nation involved. That cost will require to be largely met by increased efficiency in the industries of each nation, if distress is to be avoided. While the official imposition of indemnities and the acquisition of territory may largely adjust the balance for some participants, much of their loss by reason of trade and industrial disorganisation cannot be so recovered, but must be met by increased economic efficiency in the industries, *i.e.*, by an actual increase in the value of the product of the national energy. This can only be secured by a thorough and systematic reorganisation, coupled with a more effective training of industrial workers,

and the adoption of improved appliances and processes. We do not propose at the moment to labour the necessity for more effective industrial training, since it has been dealt with on previous occasions to some length; but we would insist that not only in the future, but at the present moment there is very much to be gained by attention to the proper equipment and conduct of works and factories. Thousands of our best workers are temporarily withdrawn from the industrial ranks, and if the economic welfare of the country is not to suffer, no effort must be spared to counteract that by increased efficiency in plant and processes. As we have already indicated, the power behind a successful war is the economic strength of the country conducting it. This was realised by Germany at the time of the Franco-German war, at the close of which Germany found herself at the lowest ebb. But by steady and strenuous application to industry and the fostering of a spirit of carefulness amongst her people, she has since made advances that stand as one of the most creditable records in the history of the world—a record unhappily marred and probably now ruined by the folly of a mad ruler. If, however, Great Britain can apply the lesson which the history of Germany can teach, we shall gain more good as a nation than any which Germany could possibly have derived from the over-ambitious schemes of imperial expansion which have landed her into trouble with the world.

The Apprentice as a "Slacker."

In discussing the efficiency or otherwise of, for example, foundry workmen, one often finds apprentices being severely criticised for their lack of initiative and energy in acquiring a wide and full knowledge of the different branches of the trade. The impression given is that it only remains for the apprentice to desire to know his trade thoroughly and to devote the necessary amount of energy thereto in order to blossom forth at the end of his full apprenticeship as a competent craftsman. Undoubtedly, to some extent, the decadence in craftsmanship which has been noted in many departments is to be placed to the credit of the apprentices themselves and their lack of desire to give the necessary attention to the details of their calling. Modern conditions, particularly in large towns, offer many distractions to those who in earlier days would have had only their trade as both occupation and hobby. At the same time this criticism does not sum up the question adequately by a very long way. One must realise in dealing with this matter that an apprentice is essentially a craftsman in the course of development and that guidance is of quite as much importance as energy and the desire to learn. No amount of willingness to acquire a knowledge of all branches of the trade would be of much service in some plants, for there are many works which are run with anything but an idea of training the young men employed. We have in the past discussed the economic phases of this subject and attempted to prove the weakness of such operations. We merely instance them at the moment to refute the suggestion that responsibility lies alone with the learner.

We must never lose sight of the fact that the most willing apprentice on entering a trade is practically ignorant not only of the rudiments of the trade but also of the lines upon which he is required to develop in order to become proficient. It is not surprising that, thrown into a large works amongst a confusing mass of operations, he most eagerly applies himself to some operation at which he can feel he is earning money. How many foremen and employers, we wonder, give their apprentices the impression that they are other than mere wage-earners for the moment? That, of course, is their ultimate function, but it can only be adequately their function by a proper course of training. The necessity for guidance and sympathetic treatment in the difficulties which all beginners encounter, and opportunity, to the best of their employers' ability, to study all sides of the work should necessarily accompany the demand that the apprentice put forward his best efforts to acquire proficiency. We must definitely refute the suggestion that responsibility lies mainly with the learner. Such is not the case, though many who are unwilling to give the necessary thought, attention and time to the proper training of their apprentices take shelter behind such a contention, in order to cover their own evasion of responsibility.

We do not pretend for one moment that much does not lie with the apprentice himself. Nevertheless we cannot agree that certain examples, oft quoted, of men who have started from the lowest rung and have fought their way to the top, are indictive of what every boy can do. It is often the case that the circumstance of being thrown on one's "beam ends," with no alternative but to fight upwards or go under, is the greatest stimulus a boy can have, since it often enables him to clarify his views and determine which is the way upwards; but many go under for the one who rises. A boy in ordinary circumstances, moreover, has to start on the basis of the schooling he has had and his own imperfect conception of what course he should take in order to progress, and from that standpoint without guidance his chances of success are heavily prejudiced. The fallacy of the criticism under discussion is in assuming that the beginner at a calling is a free agent with full discretion and ability to judge. Should not this fallacy be obvious in view of the number of adults without any serious sense of discretion?

GERMAN EXPORTS OF FOUNDRY PRODUCTS.—In the figures quoted in our last issue relating to German exports, certain classes of goods were erroneously given as "Domestic fire grates." This item should read "Domestic and cooking utensils." The returns from which the notes were compiled were not very exhaustive in detail, so we cannot say to what extent this item comprises other than cast material. As regards domestic fire grates, only a relatively small quantity is imported into this country from Germany.

MATHEMATISED ENGINEERING.—Professor A. Ranum predicts that if progress continues along the lines followed, the pure and applied mathematics of to-day will surely lead, sooner or later, to a variety of practical applications and new inventions that will startle the world. The material and utilitarian progress of to-morrow will depend largely on the scientific progress of to-day. Moreover, the increasing demand for accuracy and efficiency in engineering can be met only by broadening and strengthening its mathematical foundations. Many an engineering student of to-day will live to see the time when those engineers who are leaders in their profession, who are capable of meeting novel conditions where originality of thought and action is required, will be men who are better equipped on the scientific side than we think necessary to-day; they will be men who are thoroughly trained in the use of many of the higher branches of what we now call pure mathematics. There is doubtless a good deal of truth in Professor Ranum's contentions, but it must be remembered that pure mathematics so far have rather been applied to confirming and developing the work of practical experiment than to the discovery of new lines of progress.

The Strength of Non-Ferrous Castings.*

By L. P. Webbert.

The object of the investigations described in this Paper is to note the changes in strength that occur in different thicknesses of metal castings made from the non-ferrous metals met with in engineering practice. The knowledge desired, from the machine-designer's point of view, is how to proportion the separate parts of a design with regard to strength and to know what physical properties to expect from a casting at different points or as a whole.

Some metallurgists strive to adopt a test specimen to represent the strength of an alloy which will give the maximum results obtainable for that metal. Such test specimens give results that are interesting but tend to mislead. Quite a number of different types have been suggested for adoption as a standard, but when we consider the specifications that must be followed in practice our choice becomes decidedly restricted to a few forms.

There are two styles of test specimens made use of in practice, one for the copper-tin alloys and the other for the copper-zinc alloys. The first is that used on 88-10-2 castings (copper 88 per cent., tin 10 per cent., zinc 2 per cent.). This test specimen, as cast with the casting, has the dimensions shown in Fig. 1 (*a*). The ¼-in. gate running the entire length of the test specimen connects it with the casting. Being gated in this manner allows the test specimen to be filled quickly with metal and has the advantage of giving the same rate of cooling to

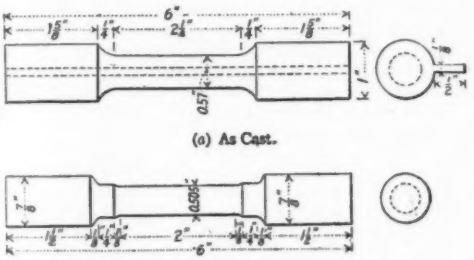


Fig. 1.—Test Specimens for 88-10-2 Castings.

every part of the specimen. When the test specimen is detached it is turned down in a lathe to the proper diameter and form as shown in Fig. 1 (*b*). In Fig. 3 (*c*) are shown the forms placed in the parting of the mould; two forms to give test specimens 0.505 in. in diameter, and one to give a test specimen 0.798 in. in diameter. When a test specimen is to be placed at another part of the casting, cores are made use of as shown in Fig. 4 (*b*) and (*c*).

For the copper-zinc alloys (manganese-bronze and brass) a bar of metal 1 by 1¼ by 6 in. is cast on the side of the casting. Fig. 3 (*b*) shows two patterns for this style of test specimen, the diameter of which is to be 0.505 in. These patterns are placed against flat surfaces. For curved surfaces different patterns are made to fit the curvature of the castings. The round part of the pattern shown in Fig. 3 (*b*) allows the pattern to be drawn easily from the sand.

It is well known that to obtain the highest results from 88-10-2 test specimens the least amount of

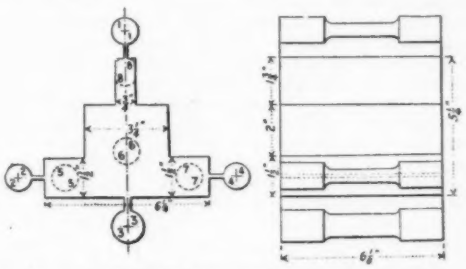


Fig. 2.—Test Block, showing Dimensions and Numbering of Test Specimens.

metal should be turned off the specimen. In comparing Fig. 1 (*a*) with (*b*) it will be noted that 0.065 in. of metal is turned from the test specimen. In the "skin" of the casting lies the greatest strength, as the foundryman puts it. To illustrate: A large valve body, ¾ in. in thickness, made from 88-10-2 metal, was cut up to procure test specimens from the flange and body of the casting, in order to compare the strength of these with the strength of the test specimen attached to the casting. The test specimen (0.505 in. in diameter) gave an ultimate tensile strength of 40,000 lb. per sq. in. and an elongation in 2 in. of 40 per cent. From the body the following results were obtained:—

	Tensile strength, lb. per sq. in.	Elongation in 2 in., per cent.
1	25,800	13.0
2	25,200	11.0

From the flange the following results were obtained:—

	Tensile strength, lb. per sq. in.	Elongation in 2 in. per cent.
1	23,650	11.0
2	18,850	5.0

When the test specimen was turned down to the proper diameter, very little of the skin was turned off. The test pieces from the interior of the metal possessed no skin and gave lower results. The results emphasize the fact that the test specimen attached to the casting exaggerates the strength of the casting as a whole.

If the diameter of this style of test specimen is increased lower results are obtained. Let us compare the 0.505-in.-diameter test specimen (0.2 sq. in. in area) with the 0.798-in.-diameter specimen (0.5 sq. in. in area). The ratio of the area of the 0.505-in. test specimen to the circumference is smaller (area ÷ circumference = 1.26) than the

* Part of a Paper presented before the American Society for Testing Materials.

ratio of the area of the 0.798-in. test specimen to its circumference (area ÷ circumference = 1.99). In the former case we state that there is more skin, so to speak, to the specimen and consequently more strength obtainable than with the larger-diameter specimen. The author has averaged 61 tests from large castings having the 0.505-in. test specimen and gives the following average:—Tensile strength, 46,580 lbs. per sq. in.; elongation in 2 in., 38.7 per cent. Among these tests a maximum tensile strength of 51,650 lbs. per sq. in. is noted, with an elongation of 62.5 per cent., which is also the maximum elongation. The minimum tensile strength among the tests is 39,100 lbs. per sq. in. with an elongation of 25 per cent. The minimum elongation is 20 per cent. The specifications under which these castings were made required a minimum tensile strength of 30,000 lbs. per sq. in. and a minimum elongation of 20 per cent. in 2 in. A specification from another source called for a minimum tensile strength of 35,000 lbs. per sq. in. and a minimum elongation of 20 per cent. in 2 in. for a test specimen of 0.5 sq. in. area (0.798 in. in diameter). This style of test specimen was placed on 10 large 88-10-2 worm wheels. The tests gave an average tensile strength of 36,324 lbs. per sq. in., and an average elongation of 27.1 per cent. The maximum tensile strength among the tests was 42,800 lbs. per sq. in., with an elongation of 36 per cent., which was also the maximum elongation. The minimum tensile strength was 29,300 lbs. per sq. in., with an elongation of 17 per cent., which was the minimum elongation. Among these 10 wheels there were two —one with a test specimen that pulled 32,500 lbs. per sq. in. with an elongation of 21 per cent., and another with a tensile strength of 29,300 lbs. per sq. in., and an elongation of 17 per cent.—that did not pass the specification. No doubt exists that had the 0.505-in.-diameter test specimen been used all tests would have given higher results.

We can conclude, therefore, that for this style of specimen used on copper-tin alloys, the smaller ratio of area to circumference of test specimen gives the greater strength. This is due to the fact that in general the rate of freezing of the metal is an important factor in influencing the strength of

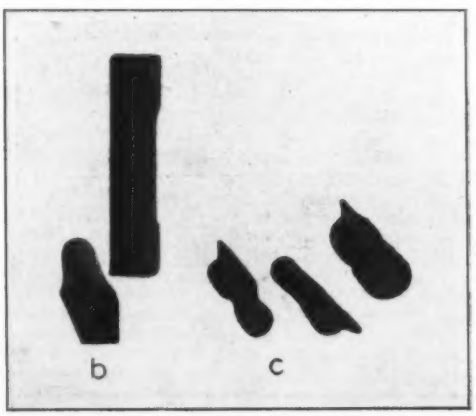


FIG. 3.—*b*, MANGANESE-BRONZE TEST SPECIMENS; *c*, TEST SPECIMENS FOR COPPER-TIN ALLOYS.

the casting. The skin of the casting receives the chill of the mould, is the first to freeze, and shows the smallest structure of grain. From the skin, freezing of the metal takes place gradually toward the centre of the casting. The rate of freezing depends upon the following factors: (1) The thickness of the casting; (2) the temperature of the metal entering the mould; and (3) the conductivity of the mould.

Variation of Strength in Parts.

In order to study the effect of the rate of freezing upon the strength of the metal, castings of copper-

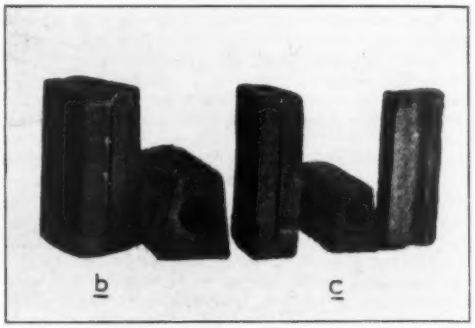


FIG. 4.—CORES USED FOR SPECIMENS 1, 2, 3 AND 4 OF FIG. 2.

tin and copper-zinc alloys were made as shown in Fig. 2, which depicts the arrangement of specimens and numbering. Test specimens Nos. 1, 2 and 4 are of the pattern shown in Fig 1. No. 3 is a similar test specimen to be turned down to a diameter of 0.798 in. Nos. 5, 7 and 8 are test specimens used on castings made of copper-zinc alloys (manganese-bronze and brass). A bar of metal is cut out of the centre of the casting and turned down into a test specimen to represent the strength of the metal at the centre. The relative advantages of these types of test specimens can be studied, since they are cast together on the same casting, are made from the same metal, and receive the same heat treatment. The specimens on all blocks made were numbered as shown in Fig. 2. Tables 1 and 2 give the results of all tests. The test specimens were not threaded but were pulled with grip jaws in the testing machine. In turning down the test specimens, Nos. 5, 6 and 7 were given a diameter of 0.798 in. The diameter was later changed to 0.505 in. in order to obtain uniformity in the size of the test specimens. Test specimen No. 3 was given a diameter of 0.798 in. for all blocks. In some instances this specimen was turned down to a smaller diameter when found slightly defective.

A few changes had to be made when casting the manganese-bronze blocks, on account of the nature of the metal. The risers were made larger, the sprues longer and the gates connecting test specimens Nos. 1, 2, 3 and 4 were made thicker. On the brass blocks the sprues were made similar to those of the manganese-bronze blocks; otherwise they were similar to those of the copper-tin alloys. After casting, the metal was churned in the riser in every case. Specimens Nos. 1, 2 and 4 were attached with the intention of observing how closely they would check each other when tested, thereby testing the reliability of this type of test specimen when made of the different metals. It may be mentioned that this type cannot be depended upon when attached to brass castings.

TABLE I.—*Analyses of Alloys.*

Alloy No.	Copper, per cent.	Tin, per cent.	Zinc, per cent.	Lead, per cent.	Iron, per cent.	Manganese, per cent.	Aluminum, per cent.	Phosphorus, per cent.
1	81.31	8.49	3.20	—	—	—	—	trace
2	87.98	10.64	1.28	0.10	—	—	—	trace
3	86.78	6.31	5.96	0.92	0.03	—	—	trace
4	84.28	11.31	4.15	0.06	0.06	—	—	trace
5	62.81	0.79	26.18	0.09	0.05	0.02	0.06	—
6a	62.81	0.79	26.18	0.09	0.05	0.02	0.06	—
7	84.49	—	15.49	—	0.02	—	—	—
8b	—	—	—	—	—	—	—	—
9	57.66	0.84	39.85	—	0.69	0.16	0.58	—
10	89.08	7.48	3.00	0.07	—	—	—	0.20

a Alloy No. 5 remelted.
b Analysis not made. Manganese bronze.

TABLE II.—*Results of Tests.*

Alloy No. 1.—*Copper-Tin; New Metal; Not Remelted.*

Test bar.	Diameter of test specimen, in.	Tensile strength lbs. per sq. in.	Elongation in 2 in., per cent.
1	0.505	40,800	28.0
2	0.505	43,250	32.0
3	—	—	—
4	0.798	35,720	24.5
5	0.505	33,750	22.5
6a	—	—	—
7	0.798	33,080	21.0
8	0.505	34,600	24.0
Average ..	—	36,866	25.3

a Specimen broke in lathe.

Alloy No. 2.—*Copper-Tin; New Metal; Pigged and Remelted. Temperature of Metal,* 2,300 *deg. F.*

1	0.505	51,250	42.5
2	0.505	50,300	40.5
3	0.798	40,660	23.5
4	0.505	50,400	39.0
5	0.798	33,740	14.0
6	0.798	28,560	9.5
7	0.798	34,200	16.0
8	0.505	40,550	28.0
Average ..	—	41,201	26.6

Alloy No. 3.—*Copper-Tin; New Metal; Not Remelted. Temperature of Metal,* 2,100 *deg. F.*

1	0.505	44,150	42.0
2	0.505	38,250	30.0
3	0.798	36,460	27.0
4	0.505	40,350	31.0
5	0.505	36,600	37.0
6	0.505	37,200	30.0
7	0.505	27,050	17.5
8	0.505	39,100	40.0
Average ..	—	37,395	31.8
Green-sand mould, average ..	—	35,190	30.5

Alloy No. 4.—*Copper-Tin; New Metal; Not Remelted. Temperature of Metal,* 2,200 *deg. F.*

1b	0.505	27,200	2.5
2	0.505	42,500	15.0
3	0.798	32,040	6.0
4	0.505	39,700	11.0
5	0.505	34,250	11.0
6	0.505	20,700	1.5
7	0.505	32,250	7.5
8	0.505	37,750	14.0
Average ..	—	34,170	9.4
Green-sand mould, average ..	—	33,502	11.0

b Defective test; not included in averages.

Alloy No. 5.—*Copper-Zinc; New Metal; Not Remelted. Temperature of Metal,* 1,800 *deg. F.*

1	0.505	39 450	34.0
2	0.505	38,000	29.0
3	0.505	43,180	42.0a
4	0.505	34,300	25.5
5	0.505	41 950	46.0
6	0.505	41,450	40.0
7	0.505	42,750	47.0
8	0.505	43,300	49.0
Average ..	—	40,548	39.0

a Defective for diameter = 0.798 in.

Alloy No. 6.—*Copper-Zinc; Alloy No.* 5 *Remelted. Temperature of Metal,* 1,840 *deg. F.*

Test bar.	Diameter of test specimen. in.	Tensile strength lbs. per sq. in.	Elongation in 2 in., per cent.
1	0.505	49,250	40.0
2	0.505	44,000	25.0
3	0.798	48,200	37.0
4b	—	—	—
5	0.505	50,000	48.0
6	0.505	49,250	47.0
7	0.505	49,800	45.0
8	0.505	50,000	46.0
Average ..	—	48,650	41.1
Green-sand mould, average ..	—	48,421	35.0

b Defective test.

Alloy No. 7.—*Copper-Zinc; New Metal; Not Remelted. Temperature of Metal,* 2,100 *deg. F.*

1	0.505	31,450	39.5
2	0.505	30,850	44.0
3	0.798	31,400	37.0
4	0.505	32,200	52.0
5	0.505	29,000	52.0
6c	—	—	—
7	0.505	28,900	55.5
8	0.505	31,700	44.0
Average ..	—	30,786	46.0
Green-sand mould, average ..	—	29,435	47.0

c Defective test.

Alloy No. 8.—*Copper-Zinc; New Metal; Pigged and Remelted. Temperature of Metal,* 1,800 *deg. F.*

1	0.505	69,150	32.5
2 (not cast) .	—	—	—
3	0.698d	69,990	29.0
4 (not cast) .	—	—	—
5	0.798	68,880	29.0
6	0.798	31,780	1.5e
7	0.798	68,740	29.0
8	0.505	67,850	25.0
Average ..	—	68,922	28.8

d Specimen defective for diameter of 0.798 in.; was turned down to 0.698 in.
e Defective test; not included in averages.

Alloy No. 9.—*Copper-Zinc; New Metal; Pigged and Remelted.*

1	0.447	73,885	26.0
2	0.505	73,200	26.0
3	0.798	73,100	24.0
4	0.798	72,800	26.0

Alloy No. 10.—*Copper-Tin; New Metal; Not Remelted. Temperature of Metal,* 2,100 *deg. F.*

1	0.505	33,000	16.0
2	0.505	40,600	28.5
3	0.798	31,480	16.0
4	0.505	28,950	10.0
5	0.505	25,750	12.5
6	0.505	27,150	16.0
7	0.505	20,600	9.0
8	0.505	40,150	48.0
Average ..	—	30,960	19.5
Green-sand mould, average ..	—	32,070	20.2

With some alloys a green-sand mould was made. This mould was filled immediately after the dry-sand mould was filled. The metal for both moulds was poured from the same crucible. The castings made in green sand gave results that showed no decided variations from those made in the dry sand. The green-sand moulds were soon discontinued. Only the average results from the green-sand blocks are given in Table II.

Conclusions.

On comparing the different tests we can conclude that the 88-10-2 test specimen as shown in Fig. 1 is convenient to use on copper-tin alloys. Incidentally, it may be noted that the average strength as given in Table II. is approached by the strength of specimens Nos. 3 and 8 for the copper-tin alloys, and by No. 8 for the copper-zinc alloys. The 88-10-2 specimen with its narrow gate was attached to a block of manganese bronze with no success. The gate was then widened to the thickness of the test specimen at the middle as used on the blocks for alloys Nos. 8 and 9. The adopted test specimen for manganese bronze (0.505 in. diameter) took the form shown in Fig. 3 (*b*). The 88-10-2 specimen was not successful with brass, due to small cracks forming in the specimen. These small cracks were not noticeable until the specimen was tested. The rate of freezing appears not to effect the copper-zinc alloys to as great an extent as the copper-tin alloys. The strength of alloy No. 2 varied from a tensile strength of 51,250 to 28,560 lbs. per sq. in. while that of alloy No. 7 varied from a strength of 31,700 to 29,000 lbs. per sq. in. With this copper-zinc alloy no cracks developed in the test specimens Nos. 1, 2, 3 and 4.

Considering a test specimen to represent the strength of a copper-zinc alloy, we can choose such a specimen as Nos. 5 or 6 for a diameter of 0.798 in., or No. 8 for a diameter of 0.505 in. (the specimen shown in Fig. 3 (*b*) is identical with No. 8). But when the copper-tin alloys are considered we cannot make a choice. In a gear blank made from 88-10-2 metal, the surface of the metal is cut away to form the teeth of the gear. It is evident that the strength of the teeth could not be represented by test specimens Nos. 1, 2, 3 and 4. If a bar of the same metal is turned down to the size of a bolt, the designer's calculations must be based on the strength of the metal represented by specimens Nos. 5 and 7.

British Foundrymen's Association.

London Branch Programme.

The 1914-1915 Session of the London Branch of the British Foundrymen's Association will open on October 16, when Mr. J. Ellis will deliver his Presidential address. This will be followed by the presentation of the diploma awarded for the best Branch Paper of the 1913-14 session, and the meeting will conclude with a brief lantern lecture by Mr. D. Gordon, on subjects of interest to the foundry trade. The succeeding meetings of the Branch and the Papers to be presented will be as follows:—

November 20.—"Foundry Troubles.: Synthesised and Analysed," by T. W. Aitken (Luton).

December 18.—"The Chemist and the Brass-founder," by R. T. Rolfe, F.I.C. (Bedford).

January 22.—"Malleable Cast Iron," by J. Stone (London).

February 26.—"A Few Notes on Mixtures of Iron for High-class Castings," by H. Pemberton (Derby).

March 26.—"Practical and Technical Aspects of Brass Founding," by A. Willis (London).

April 26.—Discussion on Reports by Branch and Central Committees on Apprentice Training.

The meetings will be held at Cannon Street Hotel, London, E.C. Further particulars relating to the Branch can be obtained from the Hon. Secretary, Mr. Alexander Hayes, 165, Strand, W.C.

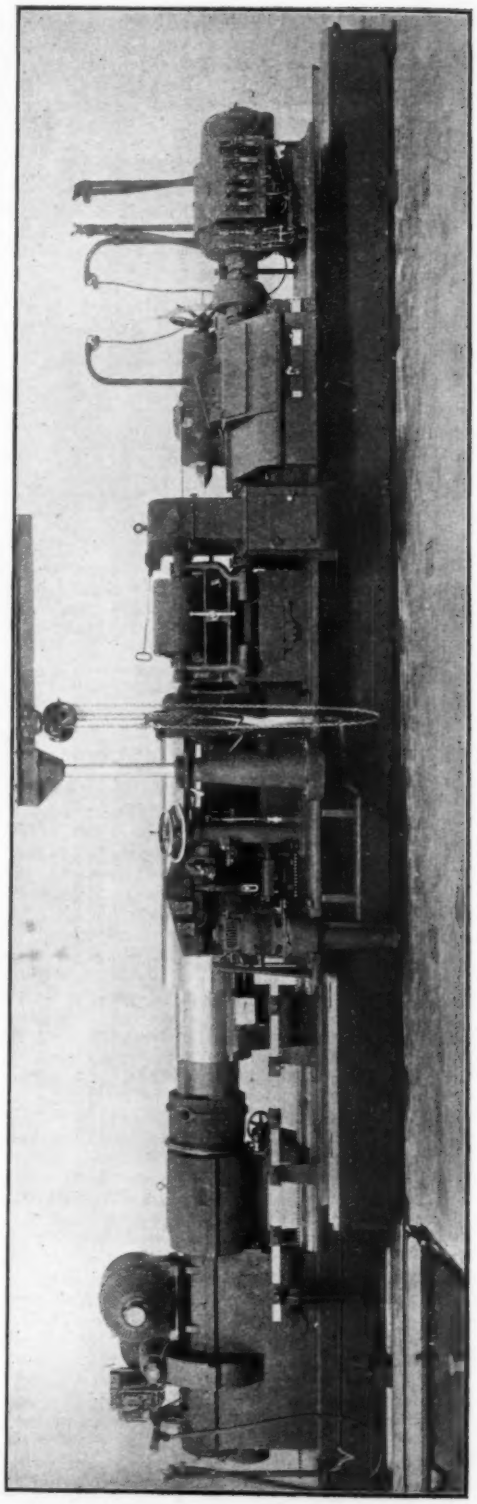


Fig. 1.—Large Cylindrical Grinding Machine; General View

Large Cylindrical Grinding Machine.

Messrs. Alfred Herbert, Limited, of Coventry, have put upon the market a heavy Norton cylindrical grinding machine to swing 54-in. in diameter and to grind work 18 ft. in length, with a capacity of 21 ft. between centres. It is equipped for grinding heavy rolls, but can be adapted for grinding plain cylindrical work up to its capacity.

The machine (a general view of which with a heavy roll mounted is given in Fig. 1) is arranged for motor drive only, the equipment comprising five motors as follows:—One 40-h.p. on the wheel carriage for actuating the grinding wheel and wheel-carriage traverse; one 15-h.p. on the headstock for revolving the work; one 2-h.p. on the back centre for traversing it; one 2-h.p. on the headstock for traversing it when required; one 2-h.p. vertical motor upon the wheel carriage for actuating the pump and for traversing the grinding wheel at right-angles to the work.

This machine is controlled in all its operations from one position, the operator standing upon the wheel carriage beside the grinding wheel in such position that he can look directly down between the face of the grinding wheel and the face of the work which is being ground, and can see what is taking place at the point of contact between the grinding wheel and roll. The upper hand wheel (Fig. 2) is used for feeding the grinding wheel toward or from the work, one revolution of this hand wheel moving the grinding wheel a distance of 0.040 in., corresponding to 0.080 in. reduction in diameter of work. If the grinding wheel is to be moved by power, the hand wheel is disengaged by moving the lever shown at the right toward the operator and locking it in this position. This raises the hand wheel, disengaging it from the wheel-feed mechanism, and at the same time releases the wheel-traverse lever at the lower left-hand side. Moving the wheel-traverse lever to the right or left operates a clutch, resulting in a movement of the grinding wheel either towards or away from the work. These levers are so constructed that the power traverse cannot be thrown in until the hand wheel has been disengaged, and *vice versa*. The lever shown at the upper left-hand side of the hand wheels controls the stopping, starting, and reversing of the wheel carriage. When automatic traverse of the wheel carriage is desired, this lever is placed in its lowest position. With the lever in the next higher position the wheel carriage can be reversed or stopped by hand. With the lever in its upper position it engages the lower hand wheel with wheel carriage traverse mechanism, permitting movement of the wheel carriage by hand. The changes in speed of work revolution are accomplished at the headstock with change gears. Intermediate speed changes for traverse of wheel carriage are made on the front of the carriage.

As the machine is designed for very large work it is imperative that the ways in which the wheel carriage travels should be perfectly straight, and to ensure this the Norton Pendulameter is used, which permits the detection of errors in parallelism as small as 0.001 in. at any point along the ways. In this connection it will be noted from the illustrations that the machine is provided with supporting wedges which are self-contained with the machine, and the alignment of the ways can thus be corrected at any time, but the ample width and length of the bearing of the wheel carriage on the ways of the base make it improbable that with the machine once set up and

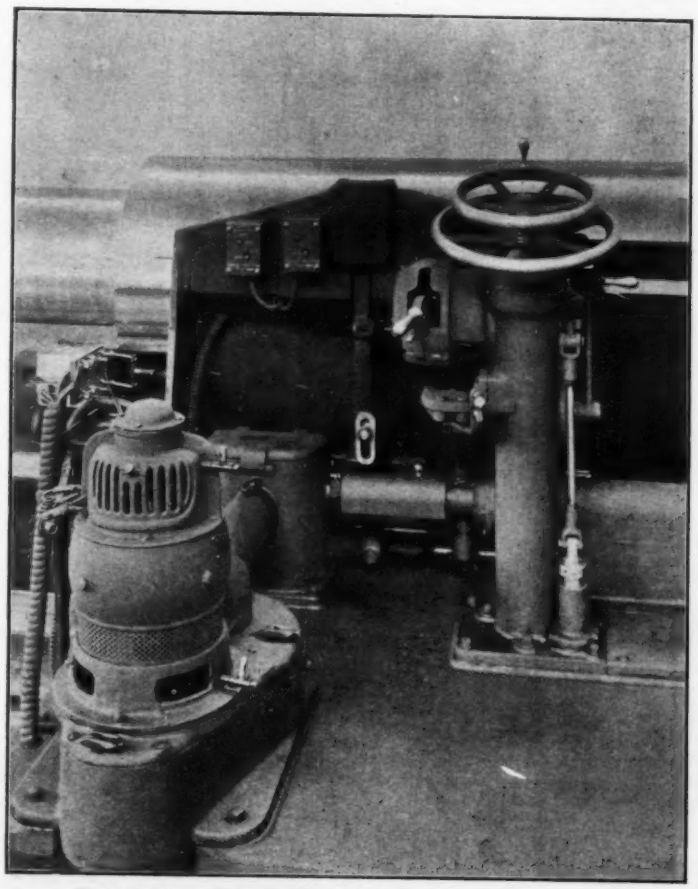


FIG. 2.—CONTROLLING GEAR; LARGE CYLINDRICAL GRINDER.

adjusted for correct alignment, any error can be detected, even after years of use.

The machine is designed in accordance with the experience of recent years—viz., that it is wholly practical to produce and maintain ways for a single grinding wheel which will secure absolutely perfect rolls, and incidentally the advantage of this single wheel is that with the present design it is possible to have the wheel large in diameter and of wide face, so mounted and provided with powerful drive as to permit the grinding in a few hours of rolls which formerly required a day or days for their grinding. Further, it is more convenient to place heavy rolls in the machine, or remove them from the machine, than is the case with machines equipped with the double wheel.

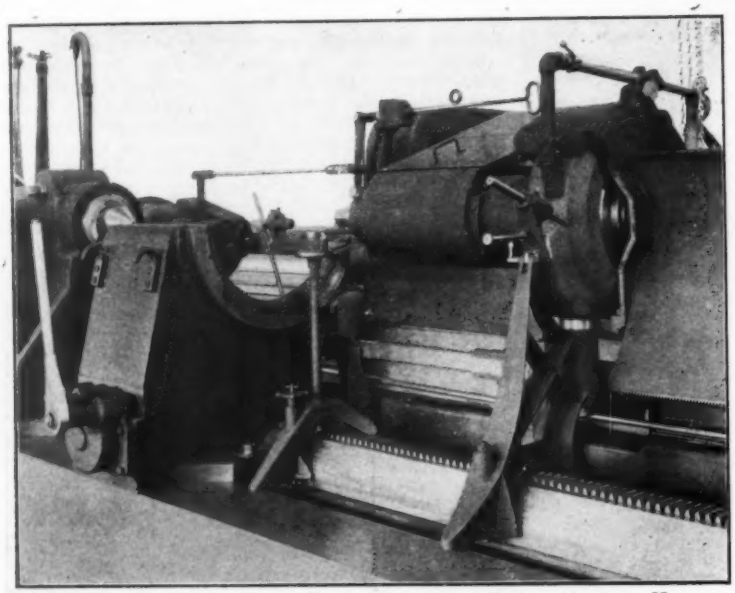


Fig. 3.—Pillow Block Bearing for Carrying Rolls on their Necks.

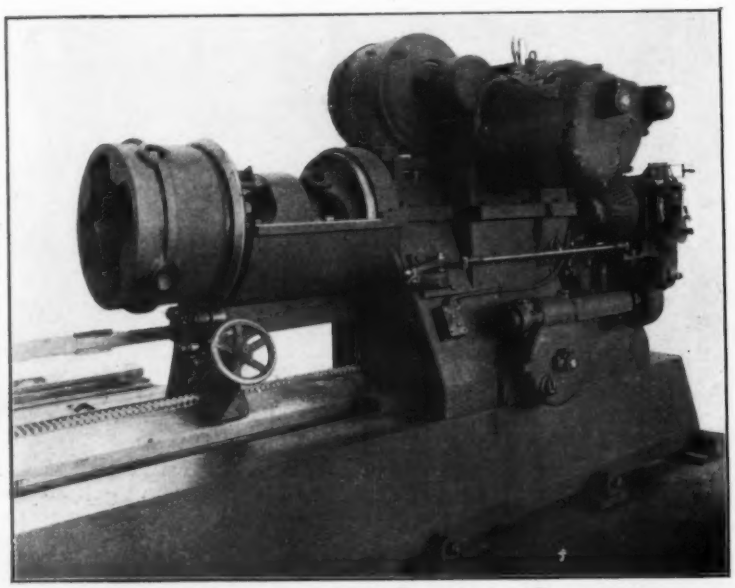


Fig. 4.—Headstock showing Roll-driving Sleeve, etc.

The first roll-grinding machine of this type was supplied to a well-known steel concern for grinding rolls to be used in the rolling of steel plates. The rolls are of various diameters and lengths, but the largest it is desired to grind is 34 in. in diameter by 18 ft. in length over all, although rolls 54 in. in diameter can be ground if desired. It will be noted (Fig. 3) that the machine is equipped with massive pillow blocks and bearings for carrying the rolls upon their necks, the largest of these necks being 24 in. in diameter. It is stated that during the demonstration of this particular machine, rolls were ground in from one-fourth to one-half the time previously required for finishing the same rolls in the lathe.

To secure perfectly smooth work, the rolls are revolved through helical gears and large worm and worm wheel running in a bath of oil. Six speeds of work revolution are provided. The headstock spindle is 12 in. in diameter; the back-centre spindle is 10 in. in diameter; the centres are 6 in. in diameter, and are interchangeable. When grinding rolls carried on their necks, they are revolved by means of a large universal joint, one end of which is bolted to the face-plate of the headstock spindle. To the other end is bolted a driving sleeve which clamps solidly to the wobbler end of the roll, revolving as a part of the roll. When grinding work on centres, the universal joint, the universal joint case and the driving sleeve are removed, and a driver is bolted direct to the face-plate on the headstock spindle.

When desired, an attachment is supplied for the machine which will permit the grinding of rolls with either a concave or convex face. The machine as illustrated is arranged for grinding rolls either straight or with straight tapers whether or not the rolls are carried on centres when being ground. The total weight of the machine, as illustrated, for grinding rolls, is about 45 tons.

Economic of the Electric-Motor Drive.*

By H. F. Stratton.

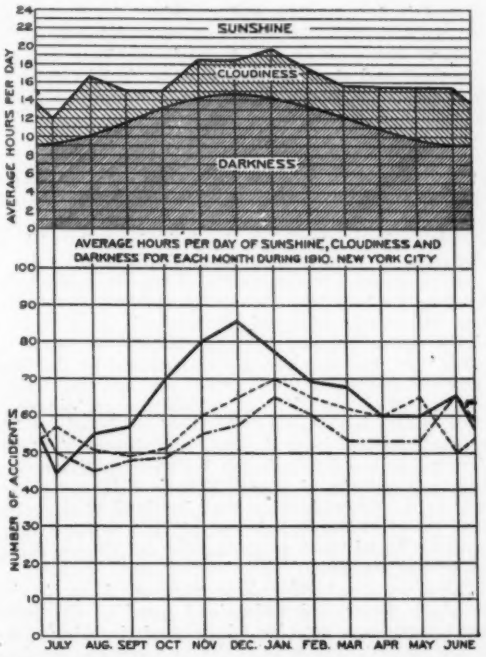
In the first portion of this Paper the author proceeds to show that in general manufacturing it pays to decrease labour costs by using labour-saving machinery and methods. He then proceeds to discuss the field for the electric motor, as follows:—

The electric motor, probably more than any other machine, is universally and importantly identified with the struggle to combat increased wages with increased production. In certain factories—for instance, the steel mills—the wonderful machinery and methods of the day would be almost chaotic without the responsiveness and controllability of the direct-current electric motor.

Consider first the basic question of increasing the capacity of any given machine, say a lathe. The real working unit is the machine plus the average workman; the value of this working unit is gauged solely by the quantity of produced work which is good enough; and the efficiency of the operation is largely the degree of intelligent co-ordination between workman and machine. The operator should be afforded the utmost convenience and responsiveness to aid him in directing the machine, and the properly controlled electric motor furnishes this link of convenience between operator and machine. In this respect, an electric motor merely supplying power furnishes the least of the possible arguments for its use. It is not electric power, but rather controlled electric power that makes this subject so full of possibility and promise. It is the ability to make the electric motor perform flexibly and automatically the various operations necessary in high-speed production. It is the responsiveness and power of the controlled electric motor that enables a workman to do more work with less fatigue. It is the elimination of useless thought, worry and physical exertion that permits a workman to devote all his energy and ability to his real task and to produce more and better work; and it is the blending of these qualities that furnishes the vital argument for the use of the electric motor. Too often we find the question of a few shillings of extra cost for power or machinery overshadowing the vital consideration of what effect the new equipment will have on production and labour costs.

Statistics relating to three different foundries over the period of one year, each of which foundries was pretty thoroughly equipped with the ordinary electric drive, show that the average cost of electric power was 2½ per cent. of the cost of labour. The important deduction to be made is that any addition to the cost of electric power—even to the extent of doubling it—is relatively insignificant if, through its added convenience, only a small proportionate increase in production or decrease in labour cost is thereby secured.

Reverting to the motor-driven lathe as illustrative, recent devolpments in controllers have provided an equipment that starts, stops, or reverses the motor in the shortest safe time, merely by moving a small lever to different positions. The operator need give no heed to the manner in which these operations are performed. The controller does this for him, automatically and better than he could do it himself. With such an equipment the operator is free from much useless mental and physical exertion. His mind is concentrated on his real task, with the obvious result that he produces not only more work but better work. The R. K. LeBlond Machine Tool Company, a large manufacturer of lathes, before deciding to recommend and furnish such equipment as standard, made exhaustive trials of this apparatus in its own shops. The increase in capacity of the lathe, due to this modernised equipment, proved to be at least 25 per cent.


SUNSHINE
CLOUDINESS
DARKNESS
AVERAGE HOURS PER DAY
AVERAGE HOURS PER DAY OF SUNSHINE, CLOUDINESS AND DARKNESS FOR EACH MONTH DURING 1910. NEW YORK CITY
NUMBER OF ACCIDENTS
JULY AUG. SEPT OCT NOV DEC. JAN. FEB. MAR APR MAY JUNE

Seasonal Distribution for Three Successive Years of about 700 Deaths Annually from Industrial Accidents reported from an Area Embracing 80,000 Plants.

As a division of this topic, the process of stopping a machine automatically by dynamic braking—which merely means the temporary conversion of the motor into a generator—instead of allowing it to come to rest merely through the effect of its friction may be examined. On a certain motor-driven boring mill, 24 seconds elapsed before the machine came to rest by drifting. With dynamic braking, the same machine was brought to rest in 2½ seconds. Wages, salaries, taxes and all overhead burdens, did not pause each time these 21½ seconds were wasted. Mr. E. P. Bullard, in a recent address, said: "What is the use of cuts at high speed, ripping things to pieces,

* Abstract of Paper read before the American Foundrymen's Association, Chicago, September, 1914.

and then losing all we gain because we cannot cut the time between cuts?"

One of the most striking characteristics of the properly controlled electric motor, from the standpoint of efficient high-speed production, is its ability to operate at widely varying speeds, in accordance with the work in hand, and its ability to maintain a predetermined speed with practical constancy. These characteristics, combined with the ease with which this speed control may be obtained, have opened up vast fields in the application of electric driving to an almost infinite variety of machines. An example is seen in the air supply to a cupola. The steady melting of iron and the steady descent of the charge from the cupola are dependent on the maintenance of uniform conditions of air pressure. In a recent installation, at the plant of the Canadian Locomotive Company, Limited, Kingston, Ont., the blower supplying air to the cupola is driven by a variable-speed, direct-current motor, the speed being varied by field control. On the wall in front of the cupola there are mounted a push button, a field rheostat and a blast gauge, all located for convenient operation by the man standing on the tapper's platform. The push button is for starting and stopping the motor, and the field rheostat is for regulating the speed of the motor. The man on the tapper's platform not only can start and stop the motor easily, but he can very definitely regulate the speed of the blower and consequently the amount of air supplied to the cupola. This man's energy is directed entirely to the proper melting of iron. He need not worry about the condition of the air supply. If the gauge indicates an insufficient supply he turns the handle of the field rheostat so as to increase the speed of the blower; and moreover, he accomplishes the desired results with the minimum of mental and physical exertion.

With automatic control and the variable-speed direct-current motor, the workman has the selection of a wide range of speeds determined by the setting of the field rheostat. These gradations of speed are much more delicate than can be obtained by the usual mechanical speed-changing devices, and any given adjustment of the rheostat provides a certain speed which varies but slightly with load conditions. The common practice is to calibrate the rheostat in terms of machine speeds—such for instance as the revolutions per minute of the drill in a drill press—and then to lay down the rule that for duplicated routine work the rheostat shall be set at that position which has been found most advantageous for the particular job in the machine.

Again, a great advantage accrues from having abundant power and maintained speed at the particular place in a machine where work is being done. In this respect, the individually motor-driven machine exhibits conspicuous advantages over any type of belt drive. In one machine shop, eight drill presses were operated from a line shaft, all of the presses working on the same kind of material and operating continuously for 10 hours each day. All the driving pulleys on the line shaft were of the same size, as were all of the driven pulleys on the presses, but the actual speeds of the presses were found to vary from 6 to 39 per cent. below the theoretical speed as determined from the ratio of the pulleys, due to different kinds of belts used and their conditions, which caused various degrees of slippage. The output of these drills was increased 20 per cent. by the installation of individual motors geared directly to the machine.

Another valuable characteristic of the controlled electric motor lies in its ability to repeat definite cycles of operation with unfailing regularity and exactness. For instance, the motor-driven reversing planer allows the cutting and return strokes to be at different speeds, either, or both, of which may be varied at will, to suit the needs of different kinds of work, and a predetermined cycle will be maintained exactly, and continuously, until the machine is stopped by its operator. A report on a planer recently equipped with reversing motor drive states that on a certain standard piece of work formerly requiring six days, since the planer was equipped with reversing motor drive, the time has been cut to three days.

The controllers for electric motors are not only simple to operate, but they may be located where most convenient and accessible to the workman, or where they will occupy otherwise waste space. An example of this occurs in connection with motor drive and automatic starting and stopping as applied to sand mills in a certain steel foundry. The only labourers permanently employed on these sand mills are used for shovelling sand and certainly do not possess any knowledge of electrical machinery. The automatic starters are mounted on columns above the crane runway and the starting and stopping push buttons are placed on the same columns near the floor. The shovellers at the sand mills find it easy to start and stop these motors by merely pushing buttons instead of possibly calling on an electrical man or foreman to perform these operations when needed.

With electric drive, individual machines may be shut down when idle, power being taken only by such machines as are in active use; thus overtime work on a few machines, often a pressing necessity, requires only the operation of their respective motors, instead of the waste of power in a long train of shafting, belts and idler pulleys.

Another considerable advantage of electric driving is the saving in space that may be accomplished and the possibility it presents of allowing machines to be placed to suit conditions of lighting, sequence of operations or easy accessibility to the supply of material. This in over-crowded plants often means the possibility of expansion without a heavy outlay in additional land or new buildings. Arrangement of machines to suit lines of shafting is extremely rigid. Electrically-driven machines may be placed where desired, from the standpoint of the manufacturing needs. Moreover the arrangement is not necessarily a permanent one—electric driving means flexibility in location and re-location. The elimination of overhead shafting often allows head-room for travelling cranes. Electric motors and controllers can be enclosed and successfully operated in locations of excessive dust and dirt, moisture and fumes.

We now come to an important phase of the subject, *i.e.*, the increase in productiveness and the decrease in accidents due to a quieter and lighter condition in factories, secured through the use of electric motors. It is rapidly becoming an established belief that better surroundings make for better work, that the health of the employé has a direct effect on his value as a producer, and that reasonable efforts directed toward the betterment of working enviroment are not only morally and ethically correct, but have their reward in increased efficiency. The electric motor helps not a little toward this desirable end. The partial or complete absence of rapidly-moving belts and shafting, with their nerve-affecting, flickering shadows, makes for better lighting, less eye-strain, less nervous strain, and fewer errors, with a lessening of defective work and, obviously, at increased marketable production. Electric driving means purer air, more cleanli-

ness, elimination of distracting noises, and more cheerful surroundings generally. Any reduction in nervous tension, mental effort and physical exhaustion leaves more energy to be applied to the task in hand.

From figures published by the Industrial Commission of Wisconsin, a certain steel plant installed an efficient lighting system, and found that the output at night was increased over 10 per cent. In order to determine whether this was due wholly to the introduction of better lighting conditions the lamps were taken out for a short period and the work carried on under the old lighting system. It was found that the amount of work fell off over 10 per cent. With the re-introduction of the improved conditions the men were again able to exceed their former rate by over 10 per cent.

As to the influence of proper illumination on accident prevention, I make the following quotation from "Modern Industrial Lighting," published by the National Electric Light Association:—"The chart, published herewith, tells graphically the story of loss and suffering which result from inadequate light. At the top we see the ratio between darkness, cloudiness, and sunlight in the city of New York. At the bottom is set forth the 'curve' of fatal industrial accidents of three successive years as reported from 80,000 industrial plants. Analyse these charts in the light of the statement of the Fidelity & Casualty Company that the greatest number of accidents occur during the months of diminishing light, and it will be acknowledged that illumination is sadly under-rated as a means of accident prevention."

Most of the arguments against the use of electric driving are founded upon the increase in investment which is represented by motors and controllers. Generally speaking, the investment in electrical equipment increases with the increase in the economies and conveniences secured by its use. Consider the following assumed installations which are progressively more expensive in first cost and more economical and safe in operation. (1) The replacement of an engine by one large motor driving the existing line shafting, the motor being started by a manual device. (2) The same motor equipped with push button starting and stopping, eliminating the need of a competent or skilled operator. (3) The same installation, but in addition equipped with rapid emergency stopping by dynamic braking, operative in case a workman is caught in some machine. (4) Several motors driving groups of machinery with a partial elimination of shafts and belting, a certain measure of flexibility of arrangement, and the ability to run or shut down one group of machines independently of the other groups. In addition, such motors may have the three types of control mentioned above. (5) A constant-speed motor individually driving a machine, eliminating belts and shafting, providing the utmost flexibility in arrangement and location of machinery, giving abundant power and maintained speed at the tool, and permitting running of the machine any time it is desired, regardless of other tools. (6) The same installation equipped with push button starters, insuring the acceleration of the motor in the shortest safe time and making the operations of starting and stopping so basically simple that any one can accomplish them and that no one can perform them incorrectly. (7) A variable-speed motor furnishing precisely the desired speed at the machine and permitting speed changes with the minimum of time and effort. (8) The same installation, but equipped with automatic control, so that the operator, by moving a small lever to different positions, can automatically start, stop, or reverse the motor in the shortest safe time. Such an equipment gives the workman the highest degree of skill and productiveness. (9) An equipment of motor and automatic control such that after the proper adjustments are made, the machine regularly duplicates a definite cycle of operation until stopped by the operator. In this, the highest development economically, the mechanism not only performs the work, but, to a large extent, does its own thinking.

Making Pulley Wheels by Plate-Moulding.

By H. Abbett.

The accompanying sketches illustrate the making of a pulley-wheel by plate-moulding. The plate and one-half of the pattern are made all in one piece and the other half is made loose, as shown in Fig. 1.

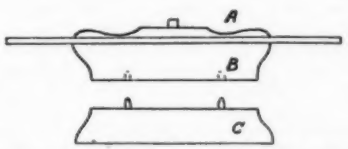


Fig. 1.—Pattern Plate for Pulley Wheel.

The flasks that will be required are a cope, a drag and an intermediate part. The intermediate part is made as shown at Fig. 2, the pins being fixed at opposite corners, two at the top and two at the bottom.

The drag is first rammed up from A, Fig. 1, and placed aside. The plate is then turned over, the two halves fitted together and the intermediate part rammed up. The joint here is made by the moulder

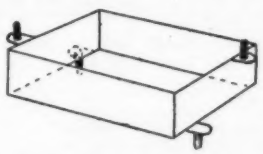


Fig. 2.—Intermediate Box Part.

himself. The pattern C is then removed and the drag, which was previously rammed up, is placed on, care being taken to see that it touches well on the joint. The whole lot is then turned over and the plate lightly rapped as it is drawn away from the mould. The cope is then made from the pattern A and the mould finished.

MOULDING SAND IN THE UNITED STATES.—According to the United States Geological Survey, the output of moulding sand in the United States in 1913 totalled 3,563,583 tons, as against 4,485,380 tons in 1912. Among the sand which is imported (chiefly as ballast) is a small quantity of French moulding sand barrelled in lump, to be ground before using.

Effect of Varying Silicon and Carbon in Malleable Cast-Iron Mixtures.*

By A. L. Pollard.

It has been the custom, since malleable cast-iron mixtures were first made up by analysis, to consider silicon as the element of prime importance. It is only recently that the effect of carbon has been studied carefully. Professor Touceda has done a very great service to the industry by investigating this subject during the past year.

The writer's attention was first called to this subject by the accident of a very low-carbon heat. The test wedges from this proved to have such excellent qualities that it seemed to offer a most interesting field for investigation. A record was therefore kept of the analysis and physical properties of every heat for a period of eight months and the data then correlated to show the effect of varying carbon and silicon.

The physical test used was that devised by Mr. Walker and standardised by Professor Touceda. Wedges 6 in. long and 1 in. wide by ½ in. at the base were cast, and annealed with the regular castings. The annealing was normal and was the same in all cases, the ovens being brought up to 1,650 deg. Fah. in 18 hours, held at 1,650 deg. Fah. for 72 hours, and cooled for about 60 hours. The wedges were then placed upon the anvil of a small drop hammer, and were given a sufficient number of 70 ft.-lb. blows to fracture them.

The hard iron analysed in every test about 0.175 phosphorus, 0.04 to 0.07 sulphur and 0.20 to 0.25 manganese. These elements, therefore, do not enter into this discussion. Only the carbon and silicon content was considered in gathering the tests into representative groups. There were, of course, variations due to improper annealing, shrinks, etc., but these were eliminated, provided the fracture showed the effect conclusively.

The results in brief are as follows. (Analyses given are for the hard iron.) :—

First series :—
Carbon 2.30 to 2.40.
Silicon 0.90 to 1.00—18 blows.
Silicon 0.80 to 0.90—24 blows.
Silicon 0.70 to 0.80—30 blows (1 test only).

Second series :—
Silicon 0.90 to 1.00.
Carbon 2.30 to 2.40—18 blows.
Carbon 2.40 to 2.50—14 blows.
Carbon 2.50 to 2.60— 9 blows.
Carbon 2.60 to 2.70— 5 blows (1 test only).

Third series :—
Silicon 0.70 to 0.80.
Carbon 2.64—15 blows (3 tests).

There was very little variation in the appearance of the above fractures. Most of them were dark grey with a lighter rim about 1/16 in. wide. The high-silicon and high-carbon fractures showed numerous crystals reflecting points of light. All samples were well annealed. The physical properties as exhibited by the above tables show uniformly high ductility on low-carbon mixtures, and where both carbon and silicon are low the properties are unusually good. The actual number of blows which the low-carbon series stood was not affected seriously by wide variations in the silicon content. The higher-silicon irons seemed somewhat stiffer.

The series of varying carbon shows, at the higher carbons, a great reduction of ductility. The results in this connection were most uniform and seem to give the carbon content an importance which has not been generally recognised.

In recording the above data, along with the foundry records showing broken and hard castings, an interesting and unexpected result was observed. The broken work on a class of thin and difficult castings had been running 2.25 per cent., and the lost work around 12 per cent., when making an iron corresponding to the third series given above. As soon as a higher-silicon and low-carbon mixture was made, both the broken and bad percentages were considerably reduced, the broken averaging 1.50 per cent. and the bad 8 per cent. The writer cannot explain why this change should render the castings less liable to breakage, but believes that the higher fluidity was responsible for the reduction in the percentage of lost castings.

Apart from the technical aspects of this question there is an important economic aspect. With pig-iron fairly high in silicon, a larger percentage of scrap can be used on high-silicon low-carbon mixtures. In a charge initially low in carbon, the silicon seems to have a lesser tendency to burn out. Especially is this fact of value in enabling the use of large quantities of malleable scrap. Below are given two typical charges with resulting analyses:—

Heat No. 223.

	Lbs.
Sprue	7,600
Old malleable	1,000
Steel	200
Pig-iron	8,200
	17,000

	Silicon.	Sulphur.	Manganese.	Carbon.
Charge analysis	1.14	0.041	0.390	2.76
Hard-iron analysis ..	1.08	Not determined.	0.210	2.22

Heat No. 506.

	Lbs.
Sprue	7,500
Old malleable	300
Steel	200
Pig-iron	9,000
	17,000

	Silicon.	Sulphur.	Manganese.	Carbon.
Charge analysis	1.17	0.043	0.398	3.02
Hard-iron analysis ..	0.93	Not determined.	0.226	2.60

A further economic consideration is that the higher fluidity of the high-silicon low-carbon heats means less loss in melting, and shorter heats. This greater fluidity is very pronounced.

In general, we conclude that where extreme ductility is desired the low-silicon, low-carbon mixture is best, but for the average class of work a high-silicon, low-carbon mixture will fulfil every requirement. It seems to reduce scrap and add greatly to the economy and ease of operation of the furnace.

* Paper read before the American Foundrymen's Association, Chicago, September, 1914.

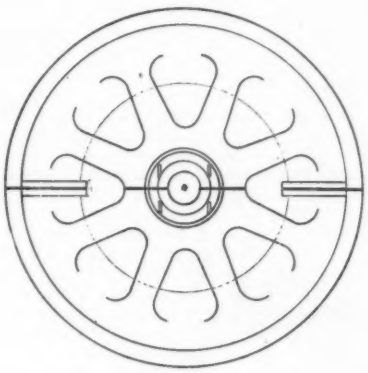
Moulding Winding Drums.

By D. Watson.

Winding drums are usually of such dimensions as to cause the founder much thought regarding to the most expeditious way of handling the work, on account of the room they take up. By the following method the job may be sub-divided and got through the shop with a minimum amount of trouble.

Figs. 1 and 2 show plan and half-section of the casting. The inside of the mould (Fig. 3) is built in a pit where the mould will be cast, a spindle with an eccentric (Fig. 4) being used to form the splitting part. In the first instance the spindle is set and the board *a*, Fig. 4, secured; the sand is levelled down hard on the pit-bottom and a course of bricks laid as at *a*, Fig. 3. Building is then continued up to

Fig. 1.



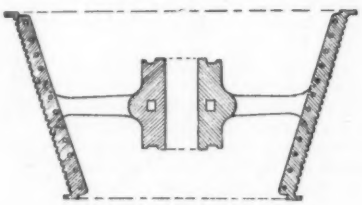


Fig. 2.

b, Fig. 3, an opening being left across the centre line for the splitting core. Loam is laid on the bricks and both halves are swept up; fires are placed round and the brickwork is thoroughly dried. The lines, as *c*, Fig. 3, are marked across the bottom and the inside (*d*, Fig. 3), rammed up with sand. A short board is fixed to the eccentric and the sand strickled off level at *b*. The division lines are marked off for the arm cores, and cast-iron plates *e* are bedded on. Cores *f*, Fig. 3 and 5, are set, and form the bottom of the boss.

The board *b*, Fig. 4, is now fixed to the eccentric and the arm cores *g* are set. These cores are made in halves, the joint being at the line *h*. The splitting lug cores *i* are now placed in, provision being made to hold them in position. Cast-iron plates *j* are placed on the arm cores and cramped each side of the core to the bottom plate *e* by cramps *k*. Brickwork is now built up between the arm cores and carried to the top as at *l*. This is swept up with loam, dried with fires as before, and afterwards blacked and dried again. When cleaned off the splitting cores, Fig. 8, are set.

Sand is now filled in the remaining space between the arm cores, the vents carried off as at *m*, Fig. 3, and a cast-iron ring *n* is placed over the boss, the space *o* rammed up with sand. The spindle can now be withdrawn and the centre core, Fig. 6, set. Next the splitting core for the boss with cotter cores attached (Fig. 7, *a*. *b*), is fixed; then the cores *f*, Fig. 5, are placed on and the boss is covered with a

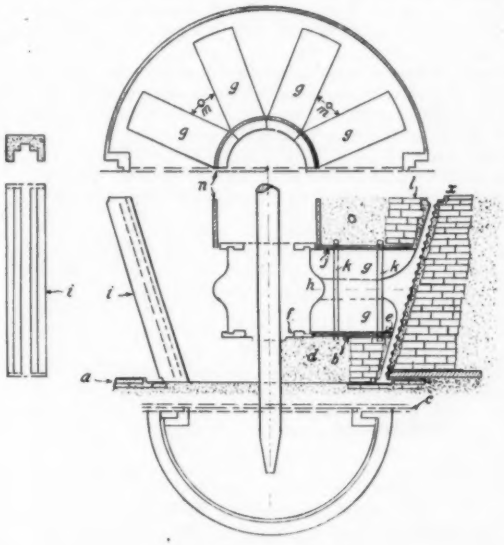


Fig. 3.

cast-iron plate, one side being daubed with loam, Fig. 9. Packing is put on to weight off and the runners carried to the top joint, the space being rammed up with sand. This section is now ready for the outside of the mould.

Fig. 11 illustrates the method of sweeping up the outside of the mould. Four cast-iron lifting plates *a* are required; these should have the bottom side daubed with a thin layer of loam and should be set in a circle round an ordinary spindle. Care should be taken when setting these plates so as to have them the right diameter, or trouble will be experienced when forming the mould. Brickwork is built up at four opposite joints, first as *b*, and left to stiffen; parting material is placed on and the whole circle proceeded with. A dummy board is used for roughing up, then the slide board *c* is attached. The cog wheel *d* is fixed to the spindle, and as the mould

board is moved round the shaft *e* is set in motion. This in turn operates the shaft *f* by two bevel wheels *g*, *g*. The thread on the shaft *f* works into an internal screw in *h*; this is fixed to the slide board. The groove board *i* should be cut very accurately so that the grooves will worm one into the other; it is

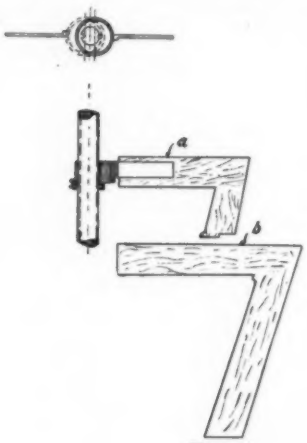


FIG. 4.

also hinged on to the slide board *c* so that when making a backward movement the sweep *i* will fall back and the board can be taken round to the top again without running through the grooves.

When finished the mould should be allowed to stiffen and then be lifted away in quarters by staples *k*. After it has been dried and blacked the quarters

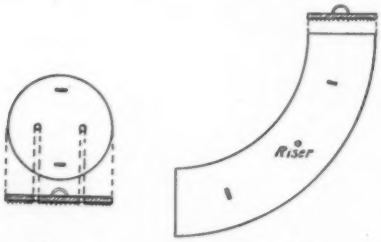


FIG. 9. FIG. 10.

are set round the inside of the mould as *x*, Fig. 3. Sand is rammed behind the brickwork to the top joint. Four segmental plates, Fig. 10, which have one side daubed with loam, are used to cover the top of the outside rim. The riser may be run off under or through the plate. The runner box is placed on and weights put on top of the plates and the mould got ready for casting.

Grindstone and Emery-Wheels Accidents.

The annual report of the Chief Inspector of Factories and Workshops points out that many breakages of grindstones are due to excessive speed, and that some limitation seems desirable. In Germany a peripheral velocity of approximately 3,000 linear ft. per minute must not be exceeded, and it has been found that in many textile-machinery and engineering works in this country the skilled heavy grinders recognise a table of surface velocities varying between 3,000 and 3,300 linear ft. per minute;

FIG. 5.

FIG. 6.

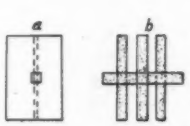


FIG. 7.

FIG. 8.

but in the cutlery and edge-tool grinding shops in Sheffield and other parts of the country, speeds between 4,000 and 5,000 linear ft. and even higher are not unknown, and general ignorance prevails both as regards the revolutions of the mill gearing and the speed of the grindstones. A surface velocity of 5,000 linear ft. per minute is generally advocated by makers of emery wheels, unless these are used on precision grinding machine tools, when a speed of 6,000 linear ft. may be allowed. Records of emery-wheel fractures show, however, that these velocities are often exceeded. In the majority of cases emery wheels can be protected by strong guards of steel or wrought-iron plate, and these should be enforced wherever practicable, even if safety flanges are provided; recent American experiments with safety flanges and guards show that guards were safest in every case. The number of accidents from fracture of grindstones and

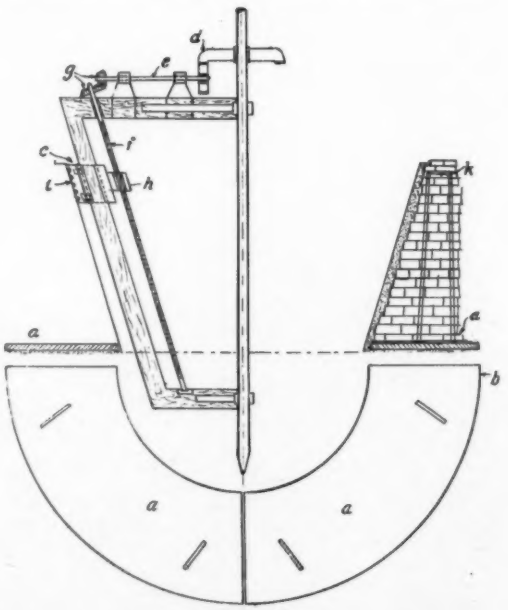


FIG. 11.

emery wheels during the year was 120, including four fatalities, an increase of 51 per cent. compared with 1912. Reported dangerous occurrences due to fracture of these appliances, without injury to persons employed, were 131,, an increase of two only on the figures for the previous year.

Tar for Basic Linings.*

The tar used for making the basic linings for steel furnaces is a product of the refining of the crude tar obtained in the manufacture of coal gas and metallurgical coke. The tars from these two processes differ in several respects, chiefly as regards their density, which is 1.10—1.18 for coke tar and 1.18—1.25 for gas tar; their percentage of light oils, 38—42 per cent. for coke tar and 32—35 per cent. for gas tar; and their percentage of free carbon, 2—6 per cent. in coke tar and 10—30 per cent. in gas tar. In addition, the quality of each class of tar is influenced by the quality of the coal used, and by the method of carbonisation, slow distillation at a low temperature giving a light, fluid tar, rich in light oils and benzols, whereas rapid distillation at high temperatures (gas retort) furnishes a thick tar, low in light oils and benzols, but high in naphtha and fixed carbon. The yield of tar varies directly with the amount of oxygen in the coal, and is increased by distilling the coal at a moderate temperature, the dissociation being less intense.

Before considering the influence of the various constituents of the tar on the agglomerative power of the mixture of tar and dolomite forming the basic lining material, it may be well to examine the immediate action of the tar on the dolomite from the moment of mixing them in the mixer. For this purpose a small lump of dolomite, about 2 in. by 1½ in., was immersed for an hour in a bath of refined tar, kept at a temperature of 176 deg. F., at the end of which time it was found that the hardness of the dolomite (originally about 4 on Moh's scale) had decreased to such an extent that it partially crushed under the hammer before breaking. The fracture had taken on a chocolate brown tint, and the core of the lump could be easily hollowed out with a penknife. The fluid constituents of the tar had penetrated through the dolomite, leaving the solid matters on the outside, and the quantity of matter absorbed amounted to 31.38 per cent. of the weight of the dolomite. Several fragments from the interior of the lump were heated in a closed crucible, and gave a slightly agglomerated mass, the hydrocarbons from the tar having formed graphitic carbon which acted as a bind.

In practice, the tar and dolomite are mixed at the above temperature, but as the mass cools quickly in mixing, it is only the light oils which penetrate into the stone. These constituents are volatilised as soon as the lining is fired in the furnace; but at the same time the previously solid constituents are melted and replace the light oils, being themselves partially volatilised and replaced by the anthracene oils as the heating progresses. In consequence of this succession of operations the dolomite grains are disintegrated and finally allow the pitch to diffuse in between them, the effect being accentuated by the acid character of some of the oils (phenols, etc.), which react with the basic matter of the dolomite. Finally, the heavy oils are decomposed, and the pitch is converted into coke so that a fine-grained mass is formed which, under the microscope, is seen to consist of mineral grains surrounded by a lustrous and porous cement of tar coke. The mass occasionally exhibits angular fragments of silica, the injurious effect of which is well known.

The external appearance of a new bottom lining does not give any evidence of the homogeneous internal structure, because, owing to the temperature rising too quickly at the edges, the active constituents of the tar are volatilised before they are able to effect the disintegration of the dolomite.

The properties of the various groups of constituents in the tar may now be considered, to see how far each assists or retards the formation of a suitable product. Complete distillation of the tar has shown the presence of light oils containing the residues of benzol and naphtha, which products are volatilised before they can dissociate and consequently do not play any part in the work of disintegration. Secondly, there is a large proportion of medium and heavy oils, the constituents of which, namely, carbolic acid and creosote, contribute to the disintegration of the dolomite, by entering into combination with its basic constituents to form phenolates of lime which decompose at higher temperatures and giving rise to a graphitic cement. Owing to the great stability of the naphthalene forming the chief member of the heavy oil group, this substance is volatilised completely when the lining is fired, and therefore takes no part in agglomeration. Thirdly, the anthracene oil obtained is readily decomposible and leaves behind a large residue of carbon. Finally, the distillates passing over between 350 and 400 deg. C. contain polymerisation products, which are useful in obtaining good agglomeration.

Of these various distillation products, the following are of use in the production of basic linings:—(1) The acid oils, because of their fluidity (which facilitates the production of a uniform mixture), whilst their acidity assists in the disintegration of the dolomite, and their decomposibility furnishes the cementing carbon; (2) the anthracene oils which though neutral are readily decomposed, leaving a large residue of fixed carbon, and the pitch and polymerised products coke to form an excellent bind. On the other hand, the following are injurious constituents:—(1) The benzols and light oils which, volatilising without decomposition, may carry off some of the useful constituents and thus constitute a source of loss; (2) the naphthalene which, when liquified by high temperatures, penetrates the dolomite and occupies the place of other constituents which are thus rendered inactive. On being expelled at about 230 deg. C., it leaves a product which lacks coherence where another substance would have been able, by decomposing, to form a graphitic cement. Free carbon if in excess is injurious, being merely inert like so much sand; and finally the organic bases neturalise and destroy the normal activity of the acid constituents.

Tests carried out by mixing dolomite with the products of the fractional distillation of the tar have shown that the fraction distilling between 280 and 350 deg. C. forms a very good bind, giving an abundant deposition of carbon, which blackens the mass and leaves it porous and without any great tendency to heat in contact with water. The fraction distilling at 350—400 deg. C. gives a mass of similar structure to the coke from bituminous coal, but darker in colour. The hardness is about the same as that of chalk, the product adheres firmly to the sides of the crucible, and very extensive decomposition is found to have taken place. The mass will no longer absorb water, and has the appearance of a bottom lining that has been fired. This last experiment demonstrates the important part played by the anthracene oils and the polymerised products.

* J. Wagner, in "Revue de Metallurgie."

The Manufacture of Crucible Steel Ingots.*

By George H. Neilson.

The modern crucible furnace is of the regenerative type and is heated by gas. The capacity of a furnace is spoken of in pots, that is, the number of crucibles the furnace will accommodate at one time. The furnace holes, in which the crucibles are placed, hold 6 crucibles, so a 36-pot furnace is one of 6 holes. The gas enters the holes at the bottom on one side, mixing with the air immediately before entering the melting hole, and passes out at the opposite side and then through the regenerator to the stack. The valve is reversed every 15 or 20 minutes and the gas should not be pulled through the melting hole too rapidly. If it is, it will cut the port holes and also cut the crucibles. The gas should fill the melting hole and show a small flame around the covers. This is a sure indication that the gas is getting around the crucible and not pulling across the bottom. The detail of the hole is given in Fig. 1.

As the crucibles generally in use hold 100 to 125 lbs., the mix or charge is weighed up in lots of that weight and placed in pans, called weigh pans, from which it is transferred to the crucibles. In order to get the exact analysis the weighing must be carefully done, in many cases to the exact ounce. When the crucible is filled it is covered with a cap. This is done to exclude deleterious gases which otherwise would impregnate the steel. When the material to be melted is weighed up the amount of carbon given off by the crucible must be taken into consideration. If this is not done the carbon content of the ingots will run higher than expected. The new pots, as a rule, do not throw off as much carbon as they do the second time used and after the third heat the amount thrown out is immaterial.

The length of time necessary to reduce the mix to a molten state varies, depending on the make-up of the mix itself, and will take anywhere from two to five hours. When the steel becomes fluid it is usually good practice to "kill it," or in other words drive out the gases which would otherwise result in blow holes in the ingot. This process of "killing" usually takes from 20 minutes to one hour or longer.

Moulds.

The moulds in general use are known as split angle moulds. They are made in two pieces, held together by rings and wedges, one ring at the top and one at the bottom. The three essential qualities are long life, smooth finish and tight joints. If the inside finish is not smooth the ingot will have a rough surface which may result in defects in the finished bar. If the joints are not tight the hot metal will work through and form a fin on the ingot. The larger moulds, 7 in. and over, have no bottoms as a rule, the moulds being set up on removable bottoms. Before the moulds are used the general practice is to smoke them with rosin, or some other heavy, greasy, smoke-making material. This prevents the ingots from sticking and also makes a smoother surface. The moulds should also be warmed before using.

Teeming is not as easy as it looks, and it takes considerable practice to make a man an expert. The weight lifted is quite considerable, the crucible and the tongs weigh about 60 lbs., and the steel about 100 lbs., a total of 160 lbs. This weight has to be lifted and held steady so that the steel will flow from the crucible evenly and at a uniform rate. Some of our strongest furnacemen never learned to teem properly. They had the strength but could not master the art. When a ladle is used, of course, the difficulty of teeming is done away with. Both methods have their advantages. It is necessary that the moulds be set up straight, or in other words plumb; if they are not the melter is more than likely to teem against the side and a mould out of plumb is likely to have a bad effect on the steel as it chills. Before the steel is poured out of the crucible the dirt which

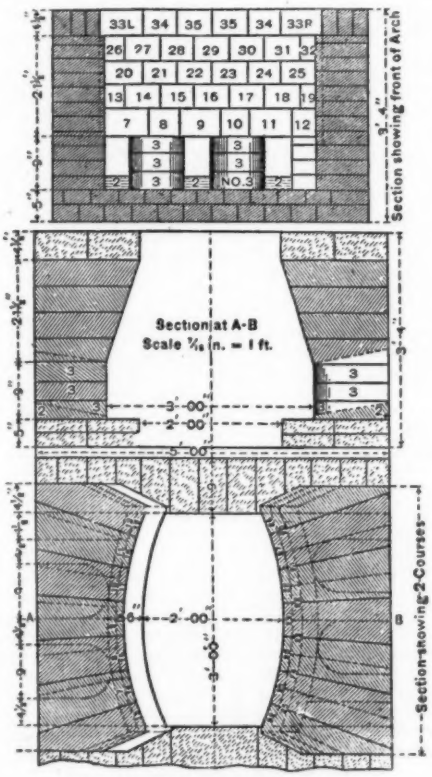

33L 34 35 35 34 33R
26 27 28 29 30 31 32
20 21 22 23 24 25
13 14 15 16 17 18 19
7 8 9 10 11 12
NO.3
Section showing front of Arch
Section at A-B
Scale ¾ in. = 1 ft.
Section showing 2 Courses

FIG. 1.—DETAILS OF HOLE IN A CRUCIBLE FURNACE.

has risen to the top should be removed. This is easily and quickly done by means of a steel rod known as a flux stick; the flux will adhere to it and can be removed without trouble.

The worst enemy of the crucible steel melter is piping.

When the ingots are cold they are removed from the mould and the top is broken off so that a clean fracture is obtained. A trained eye can tell from the fracture the carbon content of the ingot within 0.05 per cent.

* Abstract of an address before the Engineers' Society of Western Pennsylvania. The author is secretary and general manager of the Braeburn Steel Company, Braeburn, Pa., U.S.A.

The Electric Furnace in the Foundry.*

By W. L. Morrison.

The fact that the electric furnace was developed in Europe brought European practice, to a greater or less extent, with the furnace to the United States. In certain practice and for some grades of steel, European methods can be but little improved upon when the quality of steel is paramount. This covers for the main part crucible tool steel. There are so many items entering into relative costs between the crucible and the electric-furnace method, that the electric refining of steel may be carried to a nicety and still produce steel lower in cost than can be produced by the crucible method. Although this is the case, the crucible-steel manufacturers are proceeding very cautiously, and it will take several years for them as a body to put faith in the electric furnace.

The electric furnace in the foundry is a more difficult proposition, on account of the keen competition in the steel-casting trade. In Europe, raw materials, low wages and low power rates lend themselves very readily to the production of the higher grade of steel castings in the electric furnace. In some localities in America electric-steel castings are selling at a higher price than is asked for crucible steel. The customer as a rule prefers electric steel, but is unwilling to pay a higher price. The electric furnace is installed at present with the idea of replacing the crucible process, and making a better quality of steel. In many localities and for numerous purposes Tropenas converter steel is to a large extent replacing crucible steel, and the question arises whether the electric furnace can compete with the converter process.

The future of the electric furnace in the foundry will only be assured by a very close analysis of its operation, and the adaptation of its operation so as to cheapen the product and obtain a greater output. This can be done either with an acid furnace or basic furnace. For low-carbon steels (*i.e.*, less than 0.20 per cent.) low phosphorus and low sulphur are not as essential as with the higher-carbon steels. Under good operating conditions steel can be produced in the ladle from a two-ton electric furnace at from £4 to £6 per ton where no refining is necessary. This covers low-carbon steels (0.08 to 0.20 per cent.). Taking three heats per day, with ordinary care the average cost of steel in the ladle should not exceed £6, even with power at 0.75d. per kilowatt-hour. The demand at present for an alloy, or plain steel containing more than 0.40 per cent. carbon, is very limited, for the heat treatment of steel castings on a large scale is also in its infancy. In this branch of the steel casting industry the electric furnace will reign supreme, for in quality and soundness of casting it will supersede the crucible method. Steel can be melted and refined in the electric furnace for from £5 10s. to £7 per ton in the ladle, depending on the power cost, cost of materials and the care of the melter.

An electric furnace installed with the idea that one heat a day will pay its way is disastrous to the foundry. While adapted to foundry work under certain conditions, the electric furnace should not be considered as an ordinary piece of apparatus. It is very delicate, or at least certain parts are. A careless melter can add £1 to £3 to the cost of a heat from electrode breakage, by neglecting to raise his electrodes during the removal of slag, or when charging the furnace. In the charging of the furnace a certain amount of care must be exercised to insure prompt electrical contact and smooth working of the electrodes. It is very easy to lose an hour or even three hours by poor electrical contact at the outset, due to either poor charging or poor selection of scrap. On the other hand, a short-circuit the moment the arc is made and subsequent surges of current are readily overcome by placing a little slag around the electrodes.

While very-low-carbon steel can be made and poured, difficulty is encountered in pouring any considerable amount of steel into small work from one ladle. If it is desired to make 0.10 carbon steel, small heats can be made in the electric furnace for very little increase in cost, although the ladle cost, of course, would run quite high. The making of this low-carbon steel, and getting it hot enough to pour light work, is done at the expense of the arch of the furnace, which would necessarily need repairs oftener. Forced operations are also hard on the arch. Sharp corners or angles should be avoided, as they cut very quickly. A plant warranting the installation of two furnaces, and operating one basic and the other acid bottom, would offer an ideal condition, where cheap low-grade scrap is available, melting and refining on the basic bottom, then using the scrap from the basic furnace in the acid furnace.

The efficiency of the electric furnace depends upon three important factors:—The electrical design, metallurgical design, and the operation. The electrical design is perhaps the most important, and is the hardest point for the foundryman to decide upon and understand. Much talk is heard about kilowatt consumption per ton of steel in the ladle; but although one furnace might show a lower kilowatt consumption than another, in reality the power cost might be greater despite the lower kilowatt consumption, since the power factor enters into the power question. A load with a low power factor is very undesirable at the central station, and most electric distributing companies have a penalty for low power factors. If the electric company would allow a low power factor; it would be to the advantage of the consumer operating an electric furnace to use a furnace with a low power factor, as the output would no doubt be greater per kilowatt-hour. However, should the power company submit to the low power factor without a penalty, it would probably only be a matter of time till the power factor would have to be raised by further installation of electrical apparatus. There are furnaces operating with a power factor of from 90 to 97 per cent., while other furnaces on the market have a power factor as low as 40 to 60 per cent., and in order to raise their electrical efficiency they would need special apparatus, or should be operated by special alternators having a low frequency. The power consumption of furnaces should be expressed in kilovolt-amperes, so the figures given in

* Abstract of Paper read before the American Foundrymen's Association, Chicago, September, 1914.

technical literature would be less misleading. Take for example the submerged-arc type of furnace, with either three-phase or the single-phase, operating under similar conditions. Generally speaking the higher the power factor the less will be the kilovolt-ampere consumption. It is understood, when speaking of current or power consumption, that the transformer losses are included. The following is a typical illustration of the above:—A certain furnace claims a current consumption of 586 kilowatt-hours per ton of steel in the ladle, melting cold scrap, the power factor being 50 to 60 per cent. Another furnace claims 800 kilowatt-hours per ton of steel in the ladle under similar conditions, but with a power factor 90 to 95 per cent.

(1) $586 \div 0.60 = 976$ Kva.-hrs.
(2) $800 \div 0.90 = 889$ Kva.-hrs.

The former case appears the more economical of current consumption when considering the kilowatt but figuring the kilovolt-ampere consumption, the latter is about 10 per cent. more efficient. All furnaces working with a heavy inductive load must necessarily have a larger kilovolt-ampere consumption, other things being equal. To this class belong all induction furnaces, and single-phase furnaces operated on a three-phase circuit. The three-phase furnace might be included in this class during certain periods of its operation if not properly handled (that is running with an unbalanced load). The furnaces having less inductive load, and possibly lower kilovolt-ampere consumption, are those operated on three-phase and single-phase systems. The ideal current for electric furnace work is direct current, but this is objectionable on account of higher cost of installation of large units, cost of maintenance, and losses of transformation from alternating to direct current. Summing up the above, the furnace and equipment should be such as to maintain as high a power factor as possible in keeping with efficiency.

The design of the furnace for the conservation of the heat, etc., depends to some extent upon the melting stock available, and the quality of the steel to be made, that is whether an acid bottom, or a basic bottom be employed. The acid bottom is limited in its scope of operation, for while it produces a very good steel, the refining cannot be carried as far as on a basic bottom. The basic bottom is the one more commonly used.

The choice of material for electrodes for the small furnace is somewhat an open question at the present time. To meet the need of large electrodes the amorphous-carbon electrodes are being greatly improved, and are replacing the graphite electrodes in the larger furnaces. Recent developments in the manufacture of amorphous electrodes enable the splicing of two sections, and spawling is greatly decreased. The graphite electrode is still extensively used in America, and if it were not for the cost (about three times that of amorphous carbon) it would be used much more extensively. Its chief advantages are ease of machining and strength of joint between two sections, high electric conductivity, uniformity of composition, and slower oxidation under oxidising conditions. Generally speaking on small electric steel furnaces, three tons capacity and less, operating intermittently, the cost of electrodes per ton of steel in the ladle is a little in favour of the graphite. On the larger furnaces, however, the large amorphous electrodes are more satisfactory and cheaper per ton of steel made. There is little practical data on the relative merits of the two electrodes, except regarding their thermal and electrical efficiencies. However, it is well known that the amorphous carbon gives a larger area of cross section for a certain current density. The larger amorphous carbon electrode gives better distribution of heat to the steel bath, and offers some protection to the arch of the furnace. The grouping of graphite electrodes has been largely replaced by the single amorphous-carbon electrode. At present the size of graphite electrodes is limited to 8 in. diameter, on account of difficulties encountered in graphitising those of larger diameter. The only limit to size of the amorphous-carbon electrode is that which will carry safely when the furnace is tilted or during operation.

When it is desired to produce a large tonnage of soft steel, that is 0.12 to 0.15 per cent. carbon, excellent results may be obtained by the use of one slag, lowering the carbon to near the desired point, and recarburising, without attempting to whiten the slag. With the proper additions of alloys the steel will pour very fluid and sound castings will result. However, the iron oxide must be used very sparingly for decarburising, 50 lbs. to the ton of scrap usually being sufficient. Steel made this way is not quite so high grade as that made in the usual way, but it can be produced 10 to 25 per cent. cheaper. The basic bottom can be used to compete with the acid-lined electric furnace by limiting the refining.

In the making of low-carbon steel a fairly fluid slag near the finish of the heat gives hotter steel, a better cast and less tendency to skull in the ladle. Attempting to make steel castings less than 0.10 per cent. carbon, except for special purposes, is detrimental to the steel-casting trade and especially to the future of the electric furnace. The cost of producing this steel is increased at the furnace, in the foundry, and perhaps in the cleaning department. The higher temperature required to maintain a fluid metal necessitates an added repair cost and heavier overhead charges on the furnace. In the foundry larger shrink heads are required, and there is greater danger from misrun castings lowering the efficiency in the foundry. The gates and risers on the castings are harder to remove where the carbon is low. This is very noticeable even with the oxy-acetylene torch. For the great bulk of small work some foundries are considering raising the carbon content and paying more attention to the annealing.

REPAIRING MALLEABLE CAST IRON BY OXY-ACETYLENE WELDING.—The welding of defective steel and grey-iron castings by the electric and oxy-acetylene processes is, of course, well known, but the welding of malleable cast-iron presents various difficulties. It will be readily understood that the fusion of a finished malleable-iron casting reduces the malleable iron to practically its original white hard condition. Therefore, merely to weld the casting, using a malleable-iron filling rod, as in the case of welding a grey-iron casting with a grey-iron filling rod, is not satisfactory. Experiments in this work have, however, been conducted satisfactorily by the Superior Oxygen Company (U.S.A.), using oxy-acetylene welding plants. After the casting has been annealed and taken from the furnace and the defect discovered, the crack or hole is chamfered out as usual and the blowpipe flame applied until the casting becomes fused at the point to be welded. A suitable malleable-iron filling rod is then fused into the defect with the aid of a flux specially used for this purpose, until the defect is entirely closed and a smooth homogeneous weld results. At this stage of the operation the weld is very hard and brittle, but is rendered as soft and malleable as any other part of the casting by putting the casting again through the entire annealing process.

The Institute of Metals.

It having been found impossible, in consequence of the war, to hold the proposed Portsmouth meeting of the Institute of Metals last month, as originally arranged, a statutory meeting was held at Caxton House, Westminster, on September 10, when beside the transaction of official business (which included the nomination of officers for 1915, and the election of members), the nine Papers that would have been read and discussed at the Portsmouth meeting were formally presented. Abstracts of several of these Papers are given below :—

BEHAVIOUR OF COPPER-ZINC ALLOYS WHEN HEATED IN A VACUUM.

By W. E. Thorneycroft and Thomas Turner (respectively Bowen Research Scholar and Professor of Metallurgy in the University of Birmingham).

In this contribution the authors describe experiments on which they base the following conclusions:

(1) Zinc-copper alloys which consist entirely of the alpha solid solution have, with increasing temperature, a rate of volatilisation which can be represented by a curve which is a straight line throughout the greater part of its length. With alloys which are richer in zinc, the curves show considerable deviations from a straight line.

(2) The temperature of initial volatilisation is higher, and the temperature interval between initial and complete volatilisation is greater, with alloys which consist entirely of the alpha phase than with pure zinc.

(3) Alloys of the copper-zinc series may be divided into two groups according as to whether they can or cannot be quantitatively separated into their constituent metals when heated in a vacuum. Alloys containing more than 40 per cent. copper can be so separated, while with alloys which contain less than 40 per cent. of copper, part of the copper is volatilised, with the zinc.

(4) Copper-zinc alloys containing a high percentage of zinc are somewhat more volatile than pure zinc. It is not unlikely that there is one alloy which will be found to have the lowest temperature of volatilisation, or in other words, to have a higher vapour pressure than any other in the series.

(5) The heat required to separate zinc from alloys rich in copper is considerably in excess of that necessary to volatilise the liberated zinc.

(6) The exact manner in which copper volatilises from the zinc-rich alloys has not yet been ascertained.

THE CRITICAL POINT AT 460° C. IN ZINC-COPPER ALLOYS.

By O. F. Hudson (The University, Birmingham).

In this Paper the author refers to previous contributions by Professors Carpenter and Edwards, in which it was clearly demonstrated that a thermal change occurs at about 460 deg. C. in alloys containing 63—40 per cent. of copper. This critical point occurs only in alloys which contain the β constituent, and the Paper indicates the possible explanations of the change which takes place. The author remarks that he (among others) did not consider the eutectoid explanation to be conclusively proved by the evidence brought forward, a doubt which was intensified by experiments he conducted on his own account. As far as his (the author's) own results were concerned, they could be perfectly well explained by a polymorphic change in β at 460 deg. C., but there was no direct evidence against the eutectoid explanation of the transformation which occurs. It remained, therefore, to find some positive proof that β (or rather β_1) could exist as a stable phase below 460 deg. C. With this object experiments were carried out, which the author details, and upon which he bases the following conclusions :—

(1) He has not been able to obtain any evidence that β of the zinc-copper alloys breaks down into an eutectoid of α and γ at 460 deg. C.

(2) Every change which he has observed to take place in alloys containing the β constituent can be satisfactorily explained on the assumption that at 460 deg. C. β undergoes a polymorphic change to β_1.

(3) Evidence is brought forward that there is a stable β phase below 460 deg. C.

(4) The equilibrium diagram of the zinc-copper series in the β region probably has a form similar to the one shown by the author.

(5) It does not appear from the results that any unusually lengthy period of annealing is required to produce equilibrium in alloys containing the β constituent.

THE TENSILE PROPERTIES OF COPPER AT HIGH TEMPERATURES.

By Guy D. Bengough (Lecturer in Metallurgy, University of Liverpool) and D. Hanson (National Physical Laboratory).

The experimental work described in this Paper was designed originally as a continuation of the research carried out by one of the authors in 1911, an account of which was published at the annual general meeting of the Institute in 1912 (see "F.T.J.," February, 1912). The discussion of that Paper brought out certain criticisms and suggestions, with which the present authors now deal. The main conclusions that have been reached as a result of further research may be briefly stated as follows :—

(1) The nature of the atmosphere in which the tests were carried out has a most important effect upon the results obtained. An oxidising atmosphere at high temperatures gives high ductility.

(2) Pure unannealed rolled copper maintains its superior strength over annealed copper at all temperatures from atmospheric to 1,000 deg. C. Annealed copper preserves its superior ductility to approximately the same temperatures. These results were obtained in a neutral atmosphere.

(3) In the case of pure annealed copper, fracture passes through the crystals at all temperatures below about 700 deg. C. At all temperatures above about 750 deg. C. it passes between the crystals. At intermediate temperatures it may take either course, though preferentially it is intercrystalline.

(4) The existence of a range of low ductility at temperatures in the neighbourhood of 250 deg. C. to 450 deg. C. is confirmed.

(5) The effect of introducing either oxygen or arsenic in small quantities into copper is to lower the tensile strength at high temperatures. An increase in ductility is also observed.

(6) The results of the tensile tests, as a whole, can be satisfactorily explained on the basis of Rosenhain's theory of the existence of a cement surrounding the crystals, which cement is stronger than the

crystals at low temperatures, but weaker at high temperatures. Two points of interest must, however, be excepted from this statement at present.

(7) Bars tested in hydrogen at temperatures above about 720 deg. C. are weaker than bars tested in an oxidising or neutral atmosphere by about half a ton per sq. in. This is due probably to reduction of copper oxide, which may result in weakening and finally cracking the bars.

Coke Recovered from the Cupola Dump.*

By W. J. Keep.

It is common practice among foundrymen to take the half-burned coke from the cupola drop and to let the man on the charging platform use it as he pleases without weighing. As it is water-soaked the weight would not be correct and as it has been weighed once, it should not again be debited against the cupola fuel consumption. It is desirable, of course, to charge no more iron and coke than is necessary to make the last iron good. At best, considerable iron will remain unmelted or will be cast in the pig bed. A corresponding amount of coke will be left over, but much of this fuel is burned by the sharp blast and hot cupola at the end of the heat. The best practice is to decrease the coke on the last three charges and frequently the last charge of iron can be melted without the addition of coke, the heat in the cupola walls being sufficient to melt the iron. The coke left over is not considered of much value and it certainly does not appear to have much fuel value.

In the production of a certain grade of iron, it was found desirable to have the sulphur as low as possible and the trucks of coke containing exceptionally low sulphur were saved for that purpose. When we previously used Connellsville coke it was considered desirable to have the ash content about 10 per cent. so that the coke would satisfactorily carry the weight of the burden. Rarely was the sulphur less than 0.75 per cent., and frequently it was 1 per cent. or more. The by-product coke which we are now using has a firm structure and a low percentage of ash. It occurred to the writer that the burned coke should be high in ash and low in sulphur, and if so, it should be charged on the bed. Samples of by-product coke from the load from which the half-burned coke was taken were accordingly sent to the producer's chemist to ascertain the analyses of both the burned and the unburned coke. He reported that the partially-burned coke was higher in ash than the average coke and for that reason would not be quite so good for melting iron. On the other hand, it was lower in sulphur than the unburned coke and for this reason it should be more desirable for melting iron than fresh coke. Apparently the sulphur is imparted to the iron in a gaseous state and not from the molten or slag state. If the burning coke is not disturbed, the coke holds its original shape fairly well, retaining the ash as the carbon burns out, but in a cupola, the chemist ventured the opinion that the burden and the movement downward would have a tendency to separate the ash somewhat from the coke during burning.

The report of the chemist was as follows:—A sample of coke was obtained from the ovens containing 7.40 per cent. ash and 0.902 per cent. sulphur. Several pieces of this coke, about nutmeg size, were weighed, placed in a platinum dish and heated in a muffle about 1½ hours. Nearly two-thirds by weight of the coke was consumed, the volume remaining nearly the same and very little of the ash fell off while the coke burned, if it remained undisturbed. The unburned portion of the partly burned coke contained 8.86 per cent. ash and 0.706 per cent. sulphur. The ash from the burned coke contained 0.152 per cent. The weight of the pieces taken was 20.4419 grams, the amount burned off was 13.2741 grams, and the unburned coke left weighed 7.1673 grams. The ash balance was:—

Grams of ash in coke at start..		1.5127
Grams of ash in unburned coke	0.6351	
Grams of ash actually burned part	0.8764	1.5115
Unaccounted for		0.0012

Sulphur Balance.

Grams sulphur in coke at start		0.1844
Grams sulphur in unburned coke	0.0506	
Grams sulphur in ash	0.0013	0.0519
Grams sulphur gone off in gas (by diff.) ..		0.1325

0.1338 gram (0.1844—0.0506) of sulphur left the coke.
Of this 99.03 per cent. went off in gas while only 0.97 per cent. remained in the ash.

Another sample of coke was obtained containing ash, 6.96 per cent., and sulphur, 0.759 per cent. Several pieces of this coke were placed on a fireclay cylinder standing upright. The coke rested on a screen, being heated by a blast lamp burning full blast for 1½ hours. The results obtained were similar to those in the first test, although in this case some of the ash was disturbed in the coke by the blast. The unburned coke contained 9.12 per cent. ash and 0.686 per cent. sulphur. The ash from the burned coke contained 0.135 per cent. sulphur. Several other pieces of the coke were heated in the cylinder by a blast lamp for 2¼ hours, and in this case the unburned coke contained ash, 9.72 per cent., and sulphur 0.657 per cent. This shows a still greater increase in the ash and a corresponding decrease in the sulphur.

From these tests it is apparent that when coke is only partially burned, the unburned portion is higher in ash and lower in sulphur than the original coke. The ash will not fall off while the coke burns if undisturbed. Only 1 per cent. of the sulphur in the coke remains in the ash, the rest passing off in gas. Whether any of this sulphur is absorbed by the iron, and if so, what amount, can be best determined by work on a cupola in actual operation. However, if iron melted in a cupola increased in sulphur, it certainly must have taken it up from the coke, the limestone, or from some other part of the charge.

Samples of coke received from the Michigan Stove Company analysed as follows:—

Fresh coke—Moisture, 0.12 per cent.; volatile matter, 0.77 per cent.; fixed carbon, 91.43 per cent.; ash, 7.68 per cent.; and sulphur, 0.582 per cent.

Burned coke—Moisture, 0.15 per cent.; fixed carbon, 91.07 per cent.; ash, 8.78 per cent., and sulphur, 0.527 per cent.

Limestone nearly always contains some sulphur, and this may have considerable influence on the iron. The chemist ventured the opinion that it does so because much of the sulphur of the coke passes off in the gas in the form of sulphuric acid (SO_3), while the sulphur in the limestone present as CaSO would probably be partly at any rate, if not entirely, reduced to CaS, which being non-volatile, would tend to come into contact with the molten iron and give up its sulphur to it.

* Paper read before the American Foundrymen's Association Chicago, U.S.A., September, 1914.

Metal Spraying.

By R. K. Morcom.

The spraying of metals from the molten state in order to produce a powder is an old idea, and the spraying of a liquid to produce a covering of paint, varnish, or enamel, is also well known. The subject of this Paper is akin to them both, but has for its object the production of uniform metal deposits by means of a spraying process. The exact theory of the process is complex, and at present not completely understood. The spraying may be accomplished in various ways. Practical experience is demonstrating how apparatus of increasing technical convenience for the purpose may be made.

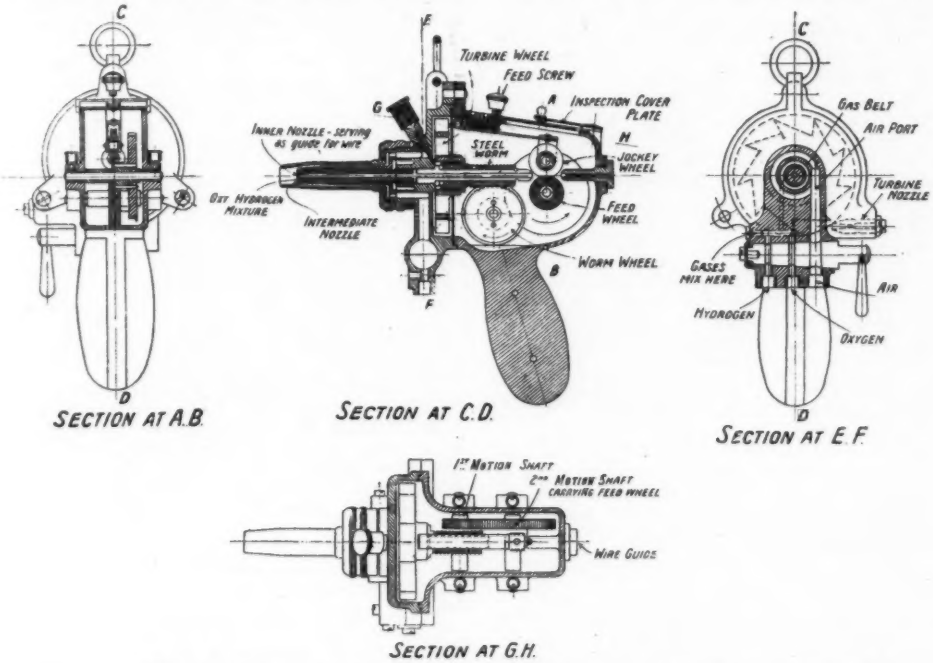


FIG. 1.—DETAILS, PARTLY IN SECTION, OF SPRAYING MACHINE OR "PISTOL."

The earliest attempts were carried out by melting the metal in a pot, forcing it through a fine nozzle under high pressure, and then with steam or a gas spraying it on to a surface. The apparatus developed for this purpose was in many ways troublesome and cumbersome, and the use of it was practically confined to metals and alloys of low melting point. The spraying medium was kept hot by various devices, and an attempt was made to keep the metal molten right up to the moment of application. The fact, however, was observed that under conditions of temperature and expansion of the gases such that the metal could not have been molten throughout the process, adherent coatings were sometimes formed. These experiments, and careful observations of the spreading and adhesion of bullets fired at an iron plate, suggested the next stage of development. Metallic powders were driven at high velocity against the body to be coated by means of gaseous jets expanded from considerable pressure. The results achieved were a great improvement on the older method.

To produce the metallic powders the metal had, of course, to be subjected to one of the known pulverising processes, such as distillation, grinding, or spraying. The suggestion that the pulverisation and deposition could be combined in one apparatus was then made by the inventor, Schoop; and his researches resulted in the perfecting of the apparatus covered by his colleague, Morf, in British Patent No. 2801 (1912).

The steady improvement of this apparatus in the laboratories of Schoop and his associates has resulted in the machine (Fig. 1). The essential parts of the machine, or "pistol," as it is called, are a combined melting and spraying jet and a feed mechanism. The metal, in the form of rod or wire, is fed to the melting flame. The flame can be formed by coal gas, water gas, acetylene, hydrogen, etc., burning in air or oxygen according to the metal used. The gases are supplied at such pressures as to prevent blowing out and to ensure a highly deoxidising flame. The spraying jet can be of carbon dioxide, nitrogen, air, steam, etc.; it is fed at such a pressure as to produce a sufficiently high velocity for successful coating. The various pressures must be carefully kept constant by accurate gauges and reducing valves.

* Paper submitted for the Autumn Meeting of the Institute of Metals.

The feeding of the wire is accomplished by a small pneumatic motor, driven by the spraying medium either in series or parallel with the main jet. The dimensions of the wire, nozzle, and feed mechanism vary with the different metals, and the nozzles and feed mechanism are so designed as to be readily interchangeable.

For small work hand operation is sufficient; but, probably, when large work is undertaken, it will prove convenient to have mechanical traverse and control.

To obtain the best adhesion, the surface on to which the metal is sprayed must be thoroughly clean and of an open nature to give a key for the deposit. Sand-blasting with sharp sand has been found best. Shot gives too polished a surface. Such surfaces as fabrics, wood, unglazed earthenware, and asbestos require only freedom from grease, as their surfaces give a natural key.

The mention of wood and fabrics as suitable substances to coat by means of an apparatus in which an intense flame is used may cause some surprise, which will be increased by the statement that celluloid, and even explosives, can be safely metal sprayed. To make this less remarkable it will be well to enter here upon a brief account of the theory so far developed to explain the operation, referring to Fig. 2 in the first instance.

The melting jet is focused at A on the tip of the wire. The spraying jet, cold from expansion, strongly draws forward the products of combustion in the centre of its cone, and by its draft drags off minute particles of metal, either in the plastic or molten state. The central cone, therefore, consists of metal particles, some cooled to solidity, some molten, and some perhaps gaseous, surrounded by a protective reducing atmosphere. This cone is hurled forward with great velocity on to the object to be coated, BC, by the outer jet.

With a given design of jet there is only a certain

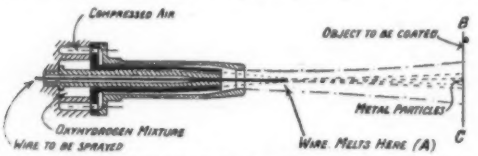


Fig. 2.—Diagrammatic Sketch of Melting and Spraying Jets in Action.

volume left by the air-jet which can be filled with flame, and this flame has a limiting temperature which cannot be exceeded. The wire, passing through this cone of flame, receives heat, partly by radiation, but chiefly by conduction, and becomes melted; but there is a definite limit to the amount of heat which can be picked up by the wire passing through the flame, and a definite limit to the rate at which it can be melted. This cannot be increased by forcing more gas into the flame, as the extra gas is merely blown away by the air-jet. It is possible to increase the rate of melting by shaping the nozzles so as to leave room for a larger cone of flame, and experiments are in progress on this point. There is, therefore, a definite and most economical quantity of gas which should be used in the pistol, this quantity being about 1.5 cub. ft. of hydrogen per minute, and 0.5 cub. ft. of oxygen; or about 0.8 cub. ft. of coal gas to 0.65 cub. ft. of oxygen for the present standard designs

In refractory metals these quantities may be increased slightly, as a slightly higher temperature can be obtained if the burning gases are under a pressure greater than atmospheric; and this occurs if the gas quantities are increased, the inner surface of the air-jet acting to some extent as an enclosing wall to the flame. On the other hand, for the more easily fusible and oxidisable metals, such as tin, lead and zinc, it is advisable to keep the gas quantities rather below the figure given, so as to avoid any possibility of overheating and burning any portion of the wire.

The outer jet performs a threefold purpose, it keeps the nozzles and wire cool, it cools the object, and it produces the requisite velocity. The velocity of the air leaving the jet will be independent of the volume discharged, and depends only upon the pressure at the jet, so long as there is no disturbance due to the entraining of air from the surrounding atmosphere. This, of course, will actually occur in practice, and the layer of air must have a certain thickness in order to prevent its being broken up, and its velocity destroyed by mixing with the surrounding atmosphere.

In addition to this, the air-jet has to atomise the molten metal, and accelerate the particles up to its own velocity, so that to perform this a certain mass of air is required.

As at present constructed the standard pistol uses about 0.55 to 0.6 cub. ft. per minute for every 1 lb. per sq. in. air pressure, so that with an air supply at 80 lbs. per sq. in., which is a very suitable figure for ordinary spraying, the air consumption will be from 45 to 50 cub. ft. per minute. The mass of this will be from 830 to 920 grammes, and the mass of metal sprayed by this air will be from about 8 grammes in the case of iron to about 200 grammes in the case of lead.

The effectiveness of the cooling is readily shown by the fact that the hand can be held in the jet, so as to receive a coating of metal, without inconvenience.

The action of deposition is probably a complex one. The minute particles of solid metal are driven with such force against the object that in some cases they fuse, but, owing to their small relative size, are promptly chilled by the object to which they adhere. If any of the particles are molten or gaseous they will adhere. In addition, the suddenly chilled particles are possibly, or even probably, in the state of unstable equilibrium found in "Prince Rupert's Drops," and act like so many minute bombs, bursting on impact into almost molecular dimensions, and penetrating the smallest cracks and fissures of the object.

The process requires some care in manipulation as, by varying the conditions, it is possible to spray porous or non-porous coatings and, with some metals, anything from a pure metal to a pure oxide. With care, however, non-porous, oxide-free, adherent coatings can be produced, of almost any metal on almost any solid.

In addition to metals, it is possible to spray fusible non-metals, or, by stranded wires, alloys of metals or mixture of metals with non-metals.

The process is so new that its uses are still partly to be developed. But it is easy to see that it may have far-reaching value for protective coatings against weather or fire, for ornament, for electrical resistance and conductors, for the production of special alloys, for joint making, and for many other purposes. Quite in a different category comes that of very fine casting. The surface of a pattern, polished or slightly greasy, is most minutely copied, and it is possible to produce process blocks very rapidly. It may be useful to line moulds before pouring in a metal. The application of the process to the production of very fine or coarse metallic powders is being investigated.

The costs of the process are not prohibitive, and, even where higher than alternative processes, the great range and adaptability of this apparatus, and its independence of muffles, pots, etc., may make it preferable.

A table of gas-pressure and feed rates is appended to give some idea of costs. Experience and extended use on a commercial scale should soon reduce the cost of operation.

The research on the lower melting-point metals has been greater than on the others, and undoubtedly the economy with them both can be greatly improved. Preheating of gases and air, supplementary flames acting in front of the main jet, and electrical methods of heating, are all still the subject of experiment.

TABLE I.—*Weight of* 1 *sq. ft. of Various Metals Coated to a Thickness of* 0.001 *in.*

Metal.	Density.		Weight.		Metal only.	
	C. G. S.	British, lb. per Cubic Foot.	Lb.	Grammes.	Price, Pence per lb.	Cost, Pence.
Aluminium	2·65	177	·0·0148	6·02	12·5	0·186
Brass	8·5	537	0·045	20·2	8·0	0·36
Bronze	8·8	565	0·047	21·1	9·5	0·45
Copper	8·9	560	0·0468	21·0	10·0	0·47
Cupro nickel	8·9	560	0·0468	21·0	...	...
Iron	7·6	492	0·041	18·4	3·5	0·144
Gold	19·3	1210	0·101	45·5	...	...
Nickel	8·9	560	0·0468	21·0	36·0	1·68
Silver	10·5	660	0·055	29·7	...	...
Tin	7·3	460	0·0384	17·3	30·0	1·15
Zinc	7·1	450	0·0376	16·9	11·0	0·415
Lead	11·4	720	0·0600	26·9	3·25	0·195

TABLE II.—*Data for Spraying Various Metals.*

Metal.	Diam. of Wire used. Millimetres.	Rate of Feed, Grammes per Minute.	Gas used per Minute, Cubic Feet.			
			Hydrogen.	Oxygen.	Coal Gas.	Oxygen.
Aluminium	1·0	9·5	1·5	0·5	0·7	0·6
Brass	0·8	17	1·5	0·5	0·8	0·65
Bronze	0·8	17	1·5	0·5	0·8	0·65
Copper	0·8	14	1·8	0·6	...	...
Cupro nickel	0·8	12	1·8	0·6	...	...
Gold	0·8	45	1·5	0·5	...	...
Iron	0·8	8	2·0	0·7	...	...
Lead	3·0	300	1·0	0·35	0·45	0·4
Nickel	0·8	0	2·0	0·7	...	...
Silver	0·8	18	1·5	0·5	...	...
Tin	2·0	200	1·08	0·3	0·35	0·30
Zinc	1·0	45	1·2	0·45	0·35	0·5

Blanks in Coal Gas column indicate that experiments with these metals are not yet complete.

The Training of Foundry Apprentices.

Meeting in Glasgow.

Under the auspices of the Glasgow School Board an open meeting of foundry foremen and others interested in the training of apprentice moulders was held in Napiershall School, Glasgow, on Friday, September 11. Dr. Dyer, Chairman of the Board, presided.

The CHAIRMAN, in his introductory remarks, stated that the object of the meeting was to enlist the co-operation of those present in the endeavour of the Glasgow School Board to introduce into their continuation classes a special class for apprentice moulders. He explained that the School Board had already been carrying on a most successful foundry trades class for the last six years. The existing class had been largely taken advantage of by students over 18 years of age, but what they now wished was to establish a graduated course for those associated with the foundry trade, and the existing class had now been divided into a course of three stages, *i.e.*, an apprentice, intermediate, and an advanced class.

Dr. Dyer then called on Mr. R. R. McGowan, the principal teacher of the class, to read a Paper on "Cupola Practice." This Paper dealt with the preparation of the cupola for a day's campaign; the height and use of the coke bed; area and arrangement of the tuyeres; pressure and volume of blast; method of charging; the proportion of iron, coke and limestone in the charge, and the melting capacity of cupolas.

At the conclusion of the Paper, a discussion on the "Training of Foundry Apprentices" was introduced by Mr. W. Mayer, of Levenbank Foundry, Dumbarton, Sen. Vice-President of the British Foundrymen's Association. He stated that the training of apprentice moulders was a subject with which he was in entire sympathy, and gave an interesting account of the system which he had inaugurated at Levenbank Foundry. He stated that the advantages to be derived by the employers taking an interest in the technical training of their apprentices was mutual. Not only was it of benefit to the apprentice and his employer, but the country also shared in the benefit.

The discussion was continued by MR. J. MATHIESON, who described some of the advantages which he thought should accrue by the establishing of a graduated course of study embracing the special needs of foundrymen, and appealed to all foundrymen present to assist the Glasgow School Board in their present endeavour.

MR. JOHN BROWN, Secretary of the Associated Iron Moulders of Scotland, made a spirited contribution to the discussion. Speaking on behalf of his Association, he wished the efforts of the Glasgow School Board every success, and assured them of every support which his Association might be called upon to give.

PROFESSOR A. CAMPION, Royal Technical College, Glasgow (President of the B.F.A. Scottish Branch), gave an interesting account of the investigations which the British Foundrymen's Association are at present bringing to bear on the subject of the training of foundry apprentices. He anticipated that the Committee appointed to investigate the matter would make their report shortly, after which a scheme would probably be suggested to guide the various educational authorities throughout the country.

MR. W. TONAGH, of Messrs. Barr & Stroud, Glasgow, described the system which his firm has in operation, which applies to all apprentices, including those engaged in the foundry. The manager of this firm decides on the classes which will be most useful to the needs of each particular apprentice, and the apprentice is advised of the classes he is to attend. At the end of each session report cards are issued to the teachers at the schools where these apprentices attended, and on their return marks are awarded by the manager for proficiency and attendance. A bonus is then added to the weekly wage of the apprentice, according to his marks. These bonuses may add 6d., 1s., 1s. 6d., or 2s. to his weekly wage during the whole year, the bonus being extra to his usual yearly advance.

MR. WILSON, the vice-convener of the Glasgow Continuation Class Committee, explained that the Board had recently considered the erection of a special building for the foundry class at Napiershall School, but in the meantime it was abandoned in view of a larger scheme which was at present before the Board, *i.e.*, the erection of a trades school, in which full provision would be made for accommodating the foundry trades class.

The meeting terminated by according a vote of thanks to Mr. McGowan for his Paper, and to Dr. Dyer for presiding.

Green-Sand Cores.*

By James Mulvey.

On account of the increased production due to improvements made in moulding machinery, many foundrymen believe that core-room practice has not kept pace with the moulding end of the business. Of late years we have had the benefit of several ingenious inventions in core machines which have enabled us to produce cores at a fraction of the cost of hand-made ones of the same character, but still we have not kept up with the moulding department. The writer now wishes to draw the attention of foundrymen to the possibilities of green-sand cores, and he speaks from the result of six years of constant contact with green-sand cores.

The green-sand core has been neglected or has not had the attention or study that it deserves, and very few give it a passing thought. There are hardly any castings of regular running work which require cores for which, with careful study, one cannot use green-sand cores to some extent. There are many concerns which are at present making castings of light weight, and some that weigh 800 lbs. each, with green-sand cores. The castings are of various shapes and sizes, and include tees, pipe fittings, or in fact almost any kind of standard work.

The advantages of green-sand cores are numerous. The writer has not seen any moulding machine on which green-sand cores can be used that can be kept away from the core-maker. Also, very little storage room, or in fact no core room, is required. When the jolt machine came on the market engineers advised that core rooms be made as large as possible. This is good advice only where dry-sand cores are used. It is not necessary to ask those foundry superintendents that have a large shop with plenty of floor space if they find it hard to pay for that space during a slack year, or in times of depression; hence the argument for the study of green-sand cores.

Green-sand cores are always ready for the moulder. One can have them as fast as one can make the moulds, and much faster. There is little mixing of sand and no baking. The caving in, shaking out the cores, and other economies over the dry-sand method will cover the cost of the rigging. The sand is used from the moulders' floors, and the small amount of facing that is used will keep the moulding sand in the proper condition. The sand should be selected according to the weight of the casting. A fine grade should be used for small work up to 10 lbs. in weight, and a more open sand for work up to 800 lbs. The sand used for the various work can be taken from the moulders' floors, as a sand that is suitable for the outside of a casting, with proper care, will be equally suitable for the inside.

Great care should be taken in venting the cores. The vents should be large and kept open to let the gas off freely; this will prevent cutting and other troubles. The shrinkage of the castings is more uniform with green-sand than with dry-sand cores, and the castings come almost true to the required size.

Green-Sand Cores for Brass Work.

Green-sand cores are valuable in casting yellow brass, the common red metal, or in fact any of the bronzes of the 88-10-2 type, as the dangers of porous castings are greatly reduced. Also, where the work must stand a hydraulic test, or where it is dipped, they will prevent troublesome spotting out. The cores should be built up on arbors and if the shape of the castings permits, the parts of the arbor should be built with a tongue and groove and dovetailed together. The tongue and groove can be cast on the arbor without any machining and should be made so they will drop in without driving; they should also be snug enough so they are not loose. The upkeep of the arbors is very small. In casting the arbors, the pattern should be made with lifting holes or handles to allow lifting the small cores from the core box; but the large cores that are too heavy to handle by hand should be provided with trunnions so they can be handled by the crane.

The large cores that are handled with a crane should be made on a drop machine or table, so the core box can be drawn away from the core. This is a much better method than drawing the core from the box and ensures better and almost perfect cores. Some core boxes can be made with hinged joints and the arbor should be made to fit the drag half of the box which carries the sand; the cope half is flopped over on the drag and then rolled back in the same position and the core removed. The object in calling attention to the rolling-back operation is to show that little motion and no time is lost in digging out core plates, beams or clamps to turn over with the core. After the cope half is rolled back and the core lifted or drawn from the box, it is ready for the mould and the core box ready for the next core. The core boxes should be well cared for and kept well waxed.

In cleaning the castings made with green-sand cores, there should be no hand-work. The cleaning can be done either with a sand-blast or with tumbling mills. The saving here alone is noteworthy. Practically no chipping is necessary, as the cores can be made very close without danger of crushing, and there are no large fins such as are got with dry sand. The pasting is entirely eliminated. The prints should be made deep so that the casting will not come too close to the flask and make the arbor close to the core box. Also the flasks should be heavy enough to stand up on jolt or squeezer machines.

* Paper read before the American Foundrymen's Association Chicago, U.S.A., September, 1914.

NEW CATALOGUES, ETC.

Westinghouse Cooper Hewitt Company, Limited, 80, York Road, King's Cross, N.—Leaflet relating to illumination by mercury vapour lamps.

James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.—A well-illustrated booklet issued by this firm deals with "Keith" centrifugal steel-plate fans, and shows these belt-driven, direct-coupled to steam engines, and motor driven. The sizes and capacities of the fans are set out in tabular form.

Alldays & Onions Pneumatic Engineering Company, Limited, Great Western Works, Birmingham.—Section Y (P) of this Company's list which has been received deals with "Sertus" patent propeller fans. These fans are of special design, and mounted in a square frame, and as they are fitted with ball thrust bearings they may be used with either horizontal or vertical spindle. The design and special fixtures of the fan are described and illustrated in the list. "Serlano" wall fans, open running, are also illustrated.

ALUMINIUM AND ELECTRIC MELTING FURNACES IN INDIA.—The United States Consul-General at Calcutta, in a report to his Government, calls attention to the aluminium industry of India. About 40 factories are said to be making aluminium ware, while the capital employed is estimated at about £667,000. It is the opinion of the Director of Industries and Commerce of the State of Mysore that great encouragement would be given to the establishment of small plants for working aluminium ware if small electric induction furnaces of, say, 10 to 20 lbs. capacity, could be introduced for melting the aluminium.

Evils Embodied in Specialisation.*

By Thomas D. West.

Specifications too often permits the inexperienced to make business ridiculous. It encourages the belief that intelligence alone will suffice to achieve success in managing men and work. As long as there remain a few true experts who can be utilised as instructors for the inexperienced the present situation may be endured, but intelligence, no matter how high, cannot replace experience in managing a business. It should be remembered that the masters developed in the old school are fast passing away. The chief excellence of the old school method consisted in its demand that a minor undergo a long apprenticeship in order to obtain substantial experience and knowledge in all the branches of his trade or profession. To-day experience is too often so superficial as to be more of a bluff than a reality. Not only are those in the shop suffering from the habit of using specialisation as a cloak to sustain inexperience or assumption, but those in the professions as well.

It is not to be understood that the writer disapproves of specialisation in modern industry. It has many commendable features and can be conducted for the benefit of man without involving any evils. To aid in this, a few facts should be forced to the front that will help greatly in bringing about a change in practice for the benefit of all concerned.

(1) The foundation work underlying the skill of artisans and professional men is not due to the efforts of specialists but general experts.

(2) Specialists could not exist without utilising some of the general expert's knowledge and experience.

(3) A general expert can work into a speciality with a great deal more expedition and effectiveness than the novice who specialises from the start.

(4) Every artisan or professional man can find a greater opportunity for becoming familiar with underlying principles in general practice than in special work.

(5) The more all-round or general knowledge and experience an artisan or professional man possesses, the better specialist can he become if he desires.

(6) The broadly trained and experienced men are much less likely to make errors and are better qualified to advance the art or science of their vocations than specialists lacking in such general experience and knowledge.

In the foundry, specialisation has been very injurious not only in decreasing the number of skilled journeymen but in causing direct loss in knowledge of the art. In this, as in most other vocations, there has been a struggle by the young to avoid giving the necessary time to apprenticeships. This has caused the supervisors of our jobbing, as well as speciality shops, to permit apprentices to assume the role of journeymen by practising but one or two of a dozen or more manipulations in which they should be thoroughly experienced. This has led to various evils, one of which appears in the difficulty foundrymen now experience in obtaining moulders, superintendents or foremen of high executive ability that are competent to take charge of the cupola, the core room, the moulding floor and to be experts in the actual work of all these three branches.

In many foundries general superintendents are now to be found who were selected from patternmakers, chemists, engineers or machinists, on account of their possession of high intelligence and executive ability, who have had but little if any experience in the actual work of the above branches. Again, a foreman who is familiar only with moulding, coremaking or cupola work may be given supervision over the whole three branches, or each branch may have an independent foreman under a superintendent inexperienced in any of the branches. This can cause no end of contention, lack of harmony, losses, etc. This is all wrong, or at least not what it should be. The superintendent or leading foreman of a foundry should have had broad experience in all details of the work involved in producing the line of castings that are being made under his supervision. The chemist, cupola men and core-makers should be controlled by him as a part of his working force, as are the carpenters, blacksmiths, and the repair force. If an intelligent, qualified youth starts early, instead of wasting time in useless studies or frivolities, and sticks to business, he can easily become master of all the branches of his vocation. We know some will admit this is all true and ask how it can be accomplished in the face of existing conditions.

The present decadence in skill and experience in such trades as founding which involves hard, dirty work can be eliminated to a large extent by working out the following suggestions:—

(1) Have everyone interested in or connected with the education and training of the young, influence them to continue their apprenticeship until they have gained the necessary insight into their vocation.

(2) Advance the doctrine that the greater the general experience and knowledge of the specialist, the greater will be his achievements in his own particular line.

(3) Create agencies that will develop and foster the conviction that the skilled and efficient workers in the trades that besmear and callous the hands are justly entitled to a wage rate far in advance of that paid to those engaged in clean clerical work that involves very little responsibility or sacrifice of time in the apprentice period.

* Abstract of Paper read before the American Foundrymen's Association, Chicago, September 1914.

FOUNDRY CLASSES AT THE L.C.C. SCHOOL OF ENGINEERING AND NAVIGATION.—We have received from the Secretary of this school the prospectus and time table for the Session 1914-15. This school, it will be remembered, includes in its equipment a pattern-shop and foundry, and the classes include instruction in patternmaking and moulding (instructor, Mr. D. Gordon). In addition to giving instructions to apprentices and others actually engaged in patternmaking, this class is intended to give to draughtsmen and other engineers who may not have had an opportunity of working in a pattern-shop the means of acquiring that knowledge of patternmaking and moulding which they necessarily require to enable them to design castings in a practical manner. Those students who are apprentices or improvers to patternmakers have opportunities of doing more difficult and advanced work. Much of the work is carried on in association with the engineering workshop, and students are able to some extent to see the castings which have been made from their patterns as they are being machined and finished.

The Dey Time Registers, Limited, of Queen Victoria Street, E.C., have amalgamated with the International Time Recording Company, Limited, of City Road, E.C., and both firms will give up their present premises. The combined businesses will be known as the International Time Recording Company, Limited, and will occupy the entire five-storey building at 30-32, Farringdon Road, E.C. This brings together two of the oldest and largest firms in the business.

American Sands for Steel Moulding.

The principal requirement of a sand for steel moulding is a high degree of refractoriness, and therefore clean quartz sand containing more than 95 per cent. silica is used. The size of the grain demanded varies with the weight of the casting and the place occupied in the mould. Steel moulding sands are commonly white, but may be yellow or light brown. Silica sand may be yellow and yet have less than 0.05 per cent. of iron. The specifications for sand bought by the Panama Canal Commission for use on the Isthmus in making steel castings were as follows:—

Sand, silica, to be sharp, free from loam and other organic matter, and suitable for steel castings; shall show the following upon analysis:—SiO_2, 95-100 per cent.; Fe_2O_3, under 1 per cent.; CaO, under 1 per cent.; MgO, under 1 per cent.

The following sieve tests of steel-moulding sands were made for the United States Geological Survey by Mr. Ralph W. Stone:—

Locality.	Retained on			
	10-mesh.	80-mesh.	100-mesh.	Pan
	Per cent.	Per cent.	Per cent.	Per cent.
Burlington, N. J.	15	83	1.5	0.5
Lake Majella, Cal.	11.5	87	1.5	—
Niles, Ohio..	32	61	4	3
Millville, N. J.	64	32	2	2
Ottawa, Ill., glass or silica	47	50	1.5	1.5
Ottawa, Ill., white steel ..	37.5	43.5	12.8	6.2
Ottawa, Ill., yellow steel .	54	40	3	3
Pacific Grove, Mo.	1	95.5	2	1.5

The sand from Burlington, N.J., was used on the Panama Canal. The test shows that it can be separated by screening into three different sizes, each of which would have its particular use in casting steel; the coarse sand is fitted for the body of a mould or parts where a smooth surface is not demanded; the medium sand for smooth surfaces, sharp corners where wear will come, and the throat of the mould through which a considerable quantity of molten metal will pass. The finest size could be used for facing parts of the mould. The raw sand is judged to be a high-grade sand for general use. In colour it is grayish white. The steel-moulding sand dug at Lake Majella is yellowish white, and is a high-grade silica sand. A grayish white sand from Niles, Ohio, which is used by a steel company in Cleveland for green-sand moulding, is found by the sieve test to be one-third 20-40 mesh and two-thirds 40-80 mesh. This is just the opposite of two sands from Millville, N.J., which are two-thirds 20-40 mesh and one-third 40-80 mesh. The sands at Millville occur in the bank in distinct yellow and white bands, which may or may not be mixed in digging. These distinct differences in percentages of different sizes of component grains adapt them to different uses in refined moulding. Steel sands from Ottawa, Ill., vary in size of grain only slightly among themselves. The yellow sand probably is as good for steel moulding as the clear white sand. These sands are derived from disintegrated St. Peter sandstone, as is also the sand from Pacific Grove, Mo. The latter has grains of the most uniform size of the sands tested.

Sand made by crushing quartzite which analyses over 95 per cent silica is also used in considerable quantities in casting steel. A sand of this kind which is produced in south-eastern Pennsylvania and is said to be used in large quantities as a steel and fire sand, varies in size from ¼ in. grain to flour. It is apparent that the size of grain varies considerably with the character of the work to be done. A sand suitable for making a mould in which steel pigs are to be cast is very different from a sand adapted to use in moulding light-weight, sharply detailed steel castings. High-grade silica sand has no bond, and a binder must be added to make a sand which can be moulded. Some steel plants use a mixture of 5 parts old or burned sand, 5 parts fresh sand, and 1 part fireclay. Another mixture is approximately equal parts of old and fresh sand gauged with silica flour, molasses water, and fireclay. Some moulders use 7 parts silica sand, 2 parts ground ganister or silica rock, and 1 part silica clay, bonded with molasses water. All these mixtures are changed to suit varying conditions.

Decarburisation during the Hardening of Steel Dies.*

By H. C. Greenwood, D.Sc. (Manch.).

In some preliminary trials of an electric muffle for hardening steel dies, the steel (containing about 1 per cent. of carbon and 1 per cent. of chromium) was allowed to soak at 820 deg. C. for an unnecessarily long time, namely, about one and a-half hours, in order to make quite sure of uniformity of temperature. The working face of the die was protected against scaling by a sheet-iron cover filled with powdered charcoal. On removal from the furnace the cover was knocked off, the face brushed free from charcoal, and the block quenched under a spray. Curiously enough, the working face which had been in contact with charcoal during the heating was found to be superficially soft, while all the other parts of the die (which, by the way, had a less sudden cooling) were perfectly hard. The surface could be filed to a depth of about half a millimetre, below which the steel was glass-hard. This behaviour was not confined to a single instance, but was observed in all cases where the surface was protected in this way. If the face were left bare the surface was perfectly hard but somewhat pitted by oxidation. This difficulty was, however, overcome by using some inert powder, such as fine sand, instead of charcoal to cover the surface, no diminution of the hardness being effected.

It only remained to seek an explanation of the paradoxical action of the charcoal in softening the surface layer. Some test-slices of the steel were accordingly taken and heated under the same conditions, packed in charcoal, for about one and a-half hours, while similar strips, unprotected in any way, were heated alongside. All were quenched together and, after annealing at 600 deg. and cleaning with emery, the respective surfaces were planed off (taking a very light cut) and combustions made of the planings. This procedure was repeated, changing round the specimens after machining off ⅛ in. from each surface. The analyses gave the following results:—

	First Experiment.	Second Experiment.
Specimens protected by charcoal	Carbon, 0.38 per cent.	Carbon, 0.59 per cent.
Specimens unprotected by charcoal	Carbon, 1.08 per cent.	Carbon, 0.87 per cent.

It is clear from these results that a decarburisation of the surfaces in contact with carbon had been effected, and this is confirmed by the fact that the soft skin persists on re-hardening. Why such an action should take place is, however, not very obvious.

* Presented before the Spring Meeting of the Iron and Steel Institute.

American Foundrymen's Convention.

Last month witnessed the annual Convention of the American Foundrymen's Association, the American Institute of Metals and the allied foundry organisations, which was held at Chicago from September 7 to 11. As will be seen by reference to the programme published in our last issue, the number and variety of Papers discussed were considerable. This rendered necessary the dividing of the meetings into sections, which enabled attention to be concentrated on each topic by those most intimately interested. At the opening meeting at the Hotel La Salle the American Foundrymen's Association, the American Institute of Metals and the Associated Foundry Foremen sat in joint session, and were welcomed by Mr. H. O. Lange, chairman of the General Committee of the Chicago foundrymen. Replies were made by Mr. A. E. Howell (President) and Mr. R. A. Bull (Senior Vice-President), American Foundrymen's Association; Mr. G. H. Clamer, President of the American Institute of Metals, and Mr. S. V. Blair, President of the Associated Foundry Foremen. The new secretary-treasurer of the American Foundrymen's Association, Mr. A. O. Backert, gave a brief address and read a telegram from the late Secretary, Dr. Richard Moldenke, who regretted his inability to attend the Convention, and expressed his best wishes for its success.

AMERICAN FOUNDRYMEN'S ASSOCIATION.

Secretary's Report.

In the course of his report, the SECRETARY (Mr. A. O. Backert) said:—

Both in prestige and membership the American Foundrymen's Association made big gains during the last year. On September 1, the membership reached a total of 807, the high point in the history of the Association, and a gain of 92 since July 1, 1913. During the year, 14 members were dropped for non-payment of fees and 12 resigned. An active campaign for new members was conducted during the months of June and July, the results of which were particularly gratifying.

For the first time in the history of the organisation, the secretary was relieved of the work entailed in securing papers and arranging for the programme for the annual meeting. At the last convention, former President H. D. Miles appointed a committee on papers and programmes, and the excellent manner in which the work has been done is reflected in the long list presented for consideration. This first experiment with a committee on papers certainly warrants its continuation.

Committee on Industrial Education.

The report of the committee on industrial education, by Mr. Paul Kreuzpointer, its chairman, stated that six States thus far have inaugurated definite systems for the organisation and supervision of industrial schools, including Pennsylvania, Wisconsin, Indiana, Massachusetts, New York and New Jersey. Decided progress has been made in the establishment of numerous corporation schools. The report discusses corporation schools at length, taking up their functions, the subject matter taught and their relation to the public school system. Continuation schools also are considered, and the proper courses of study for continuation schools are outlined.

Election of Officers.

At the annual business meeting and election of officers, the following officers were unanimously elected for the ensuing year:—Mr. R. A. Bull, Commonwealth Steel Company, Granite City, Ill., President; Mr. H. E. Field, Wheeling Mould and Foundry Company, Wheeling, W. Va., Senior Vice-President; Mr. A. O. Backert, "The Foundry," Cleveland, Secretary-Treasurer; Messrs. H. A. Carpenter, Walter Wood, S. B. Chadsey, T. W. Sheriffs, J. P. Pero, A. T. Drysdale, J. J. Wilson, A. H. Thomas, and Ben. D. Fuller, Vice-Presidents. The following Standing Committees for the ensuing year were announced:—Papers Committee; Steel Foundry Standards Committee; Committee on Specifications for Foundry Scrap; Safety and Sanitation Committee; Costs Committee; Committee to Work in Conjunction with American Society for Testing Materials on Specifications; Committee on Industrial Education; and the Committee on International Meeting, 1915.

Amended Constitution.

The report of the special committee to amend the constitution was presented and adopted. The amendments will be submitted to the membership for letter ballot. The principal change provides for associate membership, with annual fees at $5 per year, to which persons engaged in foundry work such as foremen, or firms and corporations having a commercial interest in foundry operations, but not engaged in the production of castings, are eligible. Employés of such firms also are eligible. A provision was adopted to charge an initiation fee of $5 for both classes of membership commencing May 1, 1915.

The Executive Committee was empowered to act in the matter of taking into the A.F.A. the Associated Foundry Foremen's organisation as a body.

AMERICAN INSTITUTE OF METALS.

Before this Institute also a considerable number of Papers were presented, the sessions being divided similarly to the Foundrymen's sessions.

Nomenclature of Alloys.

Mr. G. K. Burgess, of the Bureau of Standards, Washington, D.C., presented a Paper on the "Progress in the Nomenclature of Alloys." In it he gave the report of the British Institute of Metals, which he stated was the most far-reaching event in this connection. Mr. Burgess stated that in view of the simplicity of the principles advocated and for the sake of uniformity of usage, it would appear advisable for the American Institute of Metals to adopt the British suggestions.

Election of Officers.

At the business session of the Institute the following officers were elected:—Mr. G. H. Clamer, Ajax Metal Company, Philadelphia, re-elected President; Vice-Presidents: Messrs. R. B. Wallace, Robert Job, W. G. Harris, Jesse L. Jones, George C. Stone, W. H. Bassett, Fred Moerl, J. G. Kasjens, H. W. Gillett, and E. B. Horne; Secretary-Treasurer, Mr. W. M. Corse, Titanium Alloys Manufacturing Company, Niagara Falls, N.Y.

Abstracts of several of the Papers presented before the Associations are given elsewhere in this issue.

D

Electric Tool-Hardening Furnaces.

A modern steel-hardening furnace should fulfil the following requirements in order to meet the conditions required by the engineer of to-day :—

(1) Rapidly reach and easily maintain constant the particular temperature required for any given class of steel.

(2) Permit the practical recording of the exact temperature of the heated steel at any moment by means of a really efficient pyrometer attached to and forming part of the furnace itself.

(3) Heat the steel or tool uniformly throughout and without overheating or burning any of its edges or projections.

(4) Be capable of a gradual application of its heat, so as to prevent sudden stresses and strains in the steel, which would probably cause the latter to warp and crack.

(5) Not permit of the accidental contact of any foreign matter with the steel that is being heated, otherwise the carbon percentage of the steel may be altered or adversely affected.

(6) Be placed in the immediate neighbourhood of the cooling plant, so as to reduce to a minimum heat losses in the metal during its transmission from the furnace to the cooling liquid.

(7) Only permit of the least possible amount of oxidation whilst in operation.

(8) Not be dangerous to health; nor be liable to cause a fire or other damage to its surroundings.

(9) Lastly, it should be simple and reasonably economical to operate, and must be efficient in the truest and broadest sense of the term.

The furnace consists essentially of an iron case, inside of which is a lining of firebrick, together with some suitable heat-insulating substance, and built into this lining is the crucible itself containing the metallic salt bath; then, fixed into and at each side of the crucible are the electrodes which transmit the electric current through the metallic salts, thus directly applying its great and uniform heating powers to all parts of the bath.

For regulating the heat the furnace equipment includes a switch regulator, which varies the voltage. This regulating apparatus consists of an ordinary static electric transformer with the secondary winding connected to the electrodes in the bath, whilst the primary winding of the transformer, which is connected to the source of supply, is sub-divided into a number of sections connected to the regulating-switch contacts.

Appended are some interesting particulars of the times actually taken for electrically hardening several kinds of steel tools, from data supplied by the A.E.G. Company :—

Milling cutters of "Noro" Steel.

Exterior diameter. Inches.	Bore. Inches.	Width Inches.	Weight Grms.		R'ch'd °C.	With-in secs.
4.72	1.2	1	1,355	Without being warmed up direct to 1,300°.	1,300	128
4.72	1.2	1	1,355	Warmed up to dull red in the usual way, in a charcoal fire, without blast.	1,300	(?
4.5	1.26	0.8	951	Warmed up to dull red in the usual way, in a charcoal fire, without blast.	1,300	av. 50
1.5	0.68	1.8	250	Warmed up to dull-red in the usual way, in a charcoal fire, without blast.	1,300	av. 21

Bush of Ordinary Tool Steel, with Flange of 15m/m by 98m/m.

2.77	1.2	2.77	2,550	Without previous warming up.	850	243

Knives for Planing Machines of "Noro" Steel.

Length Inches.	Av. cross section. Inches.	Weight. Grammes.		Reached °C.	Within secs.
36	0.44×0.4	50	Warmed up to dull red in the usual way, in a charcoal fire, without blast.	1,300	12 to 13
36	0.44×0.4	50	Heated up by placing them on the edge of the crucible, but being still black when brought to the bath.	1,300	15

A 1-in. screw cutter of 760 grms. weight, warmed up, reached 850 deg. C. within 150 seconds.

Cracking of Drawn Brass.

In an article by Ernest Johnson, published in "Engineering Record," the author states that Muntz metal, naval brass and manganese-bronze are the three grades of forgeable brass used for structural purposes. Muntz metal is a mixture of 60 per cent. copper and 40 per cent. zinc. This mixture, hardened by the addition of less than 1 per cent. of tin, is called naval brass, and if further hardened by a slight addition of iron it becomes manganese-bronze.* Cold-worked brass may fly to pieces if the metal is not annealed at suitable intervals during working. This is especially true of alloys containing about 50 per cent. copper, and naval brass and manganese-brass are even more susceptible to initial straining than Muntz metal. In the new Catskill (New York, U.S.A.) aqueduct hundreds of bolts were found cracked, due apparently to the extreme natural range of temperature encountered through a winter. There is no evidence that the chemical composition of the brass had anything to do with the season cracking, excepting that it made the alloy hard. Analyses of the cracked portion and the solid core showed no essential difference between the two distinct areas of the metal. The analyses also showed freedom from any other elements which might have caused the peculiar behaviour of the metal. Cracking is more likely to occur in a hard than in a soft alloy, especially when hardened with tin and iron. Season cracking occurs only in copper alloys that have had some cold work done on them. Ten per cent. aluminium-brass hot-rolled bars did not suffer from season cracking while cold-drawn bars of the same material did crack. In the Catskill aqueduct hundreds of studs were found cracked, but not a single short bolt which had to be heated for the purpose of upsetting was damaged. All the defective studs had cracks in the unthreaded portion, and but few studs were broken in the thread, which would indicate that machining off the surface, as is done in cutting threads, eliminates the danger of cracking. Cracked manganese-brass shows a considerably higher hardness under the scleroscope, and the elastic limit of the cold-drawn bars is said to increase toward the surface.

*From the context it is evident that the author refers to manganese-brass and not manganese-bronze or the copper-tin-manganese alloys. We have accordingly used the term manganese-brass throughout instead of manganese-bronze as appears in the original.—[Editor, "F.T.J."]

Continuing, the author states that it is a question whether manganese-brass, naval brass, and perhaps all high brass, should be unconditionally condemned as unfit for structural purposes, or whether these alloys might be safely used if certain precautions were taken. He contends that since hot-worked manganese-brass rods and bars, both extruded and hot rolled, give 70,000 lbs. ultimate strength and 40 per cent. elongation in 2 in., and naval brass produced by the same methods gives 50,000 lbs. ultimate strength and 40 per cent. elongation in 2 in., there seems to be little real need for cold-drawing. Whenever it is impracticable to eliminate cold-working, the initial stresses set up by the cold-working should be eliminated by annealing. When great stiffness is desired, cold-drawn bars must be used without annealing, but such material must be prepared with care to eliminate the initial stress due to the drawing.

The following specifications for rolled, extruded, and drawn brass are then given :—

Composition.

——	Copper.	Tin.	Iron.	Lead.	Zinc.
	Per cent.	Per cent.	Per cent.	Per cent.	
Muntz metal ..	59–62	—	—	0.6 max.	Rem.
Naval brass ..	59–62	0.5–1.25	—	0.2 max.	Rem..
Manganese brass	57–61	0.5–1.25	0.5–2.0	0.2 max.	Rem

Minimum Physical Requirements for Hot-rolled, Extruded, and Annealed Material, in Lbs. per Square Inch.

——	Yield point.	Ultimate strength.	Elongation per cent.
	lbs.	lbs.	
Muntz metal	20,000	50,000	32
Naval brass	22,000	56,000	32
Manganese brass	27,000	68,000	32

Drawn Material not Annealed.

——	Yield point.	Ultimate strength.	Elongation per cent.
	lbs.	lbs.	
Muntz metal	25,000	50,000	25
Naval brass	30,000	60,000	25
Manganese brass	35,000	70,000	25

It will be noted that the author makes no mention of the manganese content of the manganese-brass alloy, although this varies in different compositions from a trace to as much as 3 per cent. Aluminium up to 0.5 per cent. also is a very common addition to manganese-brass, but this is not mentioned. Perhaps the author does not countenance aluminium in an extrusion alloy.

Economies in Sand Manipulation.*

By A. M. Thompson.

The introduction of new kinds of binders and of sand-mixing machinery has brought about a condition in some shops whereby all the core sand may be used over indefinitely, with only sufficient new sand added to take care of the waste.

As an illustration of this, some years ago in our foundry, the formula for core sand for arm cores for wheels or pulleys, rim cores, etc., consisted of 80 per cent. of sand and 20 per cent. of old sand. This large percentage of new sand necessitated hauling the cores out to the dump pile after they were knocked out of the castings, and paying for having them carted away. The amount of new sand has been gradually reduced and gang-way and old core sand increased until the formula now used is 20 per cent. of new and 80 per cent. of old sand, this amount of new sand being necessary to give it body.

For green sand facing, we are using one-third new moulding sand, one-third heap sand and one-third old cores which have been crushed in a cinder mill. These sand mixtures are mixed in a pan mill in this manner :—The heap sand and core sand are shoveled into the mill; then the new moulding sand and sea-coal or core compound, as the case may be, are added, making altogether 4 cub. ft. of sand. The mill is set in motion, and in five minutes the sand has been thoroughly incorporated and not a vestige of the new sand can be detected, the mixture being strictly black in colour.

The action of the mill is to squeeze the old sand into the new sand and to separate the clay grains so that by the time the operation is done the light-coloured new sand has entirely disappeared, or, in other words, is completely dissolved. If the mill is allowed to run longer, the sand gets tough and is in better shape for gear teeth and deep-lifts and the sand (which, if mixed by the ordinary processes of shoveling and riddling, would have no bond and be unsatisfactory for facing) can be made as strong or tough as desired.

The following tables will show what can be accomplished in a jobbing shop of 25 or 30 moulders :—

Core Sand.

	s.	d.
Formerly Used.		
40%, or 800 lb., of new molding sand, at 5s. per ton .	2	0
40%, or 800 lb., of new sharp sand, at 2s. 6d. per ton	1	0
20%, or 400 lb., of old core or gang-way sand ..		
1 to 40, or 50 lb., compound	3	2
Total	6	2
Now Used.		
20%, or 400 lb., of new molding sand, at 5s. per ton..	1	0
80%, or 1,600 lb., of old core sand		
1 to 80, or 25 lb. compound	1	7
Total	2	7
Difference in cost per ton	3	7

Facing Sand.

	s.	d.
Formerly Used.		
⅓, or 666 lb., new molding sand, at 9s. 10d. per ton ..	3	8
⅓, or 666 lb., heap sand		
⅓, or 666 lb., heap sand or old core sand		
1 to 10, or 200 lb. sea coal, ...	2	11
Total	6	2
Now Used.		
⅓, or 666 lb., of new molding sand, at 5s. per ton ..	1	8
⅓, or 666 lb., heap sand		
⅓, or 666 lb., heap sand or old core sand		
1 to 10, or 200 lb., sea coal	2	11
Total	4	7
Difference in cost per ton	1	7

The difference in cost is because of the cheaper grade of new sand, it being possible to use this in the mixer.

Core Oil-Sand.

By mixing core oil-sand in a machine, a less quantity of oil is needed to give the same bond in the sand. The ratio when mixing by shovel and riddle was 1 to 45, while mixing by machine it is 1 to 60. The difference amounts to 25 per cent. A foundry using 50 gallons a month at 1s. 8d. per gal. would save £1 1s. per month.

Summary.

Core sand, 3 tons at 3s. 6½d.	10s. 8d per day or	£160 per year
Facing sand, 3 tons, at 1s 7d.	4s. 9d. per day or	£92 per year.
Core oil-sand		£12 per year.
Total saving		£264 per year.

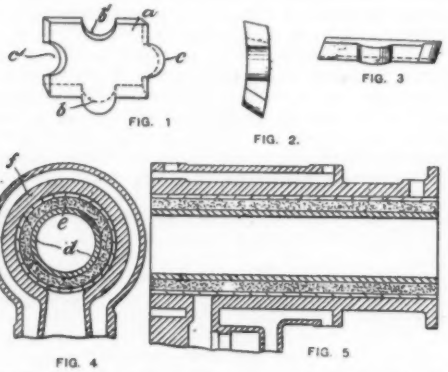
To this may be added a saving of £62 a year in labour of mixing

* From a Paper read before the Chicago Foundrymen's Club.

Invention.

Abstract of British Patent Specification recently Accepted.

11,703 (1913). *Chills Employed for Hardening and Toughening Cast Metal Cylinders.*—A. H. Wheldon and G. Hands, 13, Brewery Street, Altrincham.—Fig. 1 is a plan, Fig. 2 an end view, and Fig 3 a side view of one form of sectional chill; Fig. 4 is a transverse section, and Fig. 5 a longitudinal section, of a cylinder showing the application of the invention. A chill is made composed of sections *a*, provided with projections *b* and *c*, and corresponding recesses b^1 and c^1. When the sections are assembled, the projections on one section engage the corresponding recesses in the adjacent sections. The



Chills for Hardening and Toughening Cast Metal Cylinders.

sides of the sections *a*, projections *b* and *c*, and the recesses b^1 and c^1 are bevelled so that when the sections are assembled their edges overlap. In use the sections are assembled around a core, comprising a tube *d* (Figs. 4 and 5) surrounded by sand or loam *e*. The sections are pressed into the sand or loam and fill the space between the loam core and the interior of the cylinder *f*. The overlapping bevelled edges allow of the ready displacement of the sections *a* on the removal of the sand or loam core *e*, after the cylinder or tube has cooled, and they also prevent the sections from being wedged tightly together by the contraction during cooling.

Correspondence.

Hints on the Cupola.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to the letter from "Tyro," concerning my short article on the above subject, published in August issue, I may say that the proportions of fuel and iron are parts by weight and not measure. Fluorspar is the best known flux, but owing to its price it is not within the reach of every founder. The next best materials are marble spalls and limestone, especially the spalls, as they are a purer limestone than other forms. I am unable to give the chemical constituent parts of the flux, as they vary in different districts, but the quarry proprietors will always be pleased to submit them upon request.

Yours, etc.,
"G. H. W."

Colchester.

Northampton Polytechnic Institute.

The Northampton Polytechnic Institute, St. John Street, London, E.C., which is one of the very few institutions that teach foundry work, has just issued its annual volume of announcements for Session 1914-1915.

Equipment.—During the past year the equipment of the various departments has been extended in many directions. Amongst the more important items may be mentioned in the mechanical engineering department a complete two-stage air compressor-plant designed for experimental work in engineering problems in connection with the compression of air and also providing a supply of pressure air for penumatic tools, etc. The equipment for aeronautical engineering and for the testing of materials under repetition stresses has been extended, and in the engineering workshop some additional important tools have been added. In the electrical engineering department the equipment of precision testing instruments has been extended, and numerous additions have been made to the equipment in all the laboratories. In all departments a fair amount was spent on extensions during the Session 1913-14.

Classes.—The programme of work for the new Session was necessarily arranged before the present abnormal state of affairs arose, and the published "announcements" set forth schemes of work which were contemplated without any prevision of the serious disturbance which has arisen. How far this work can now be carried into effect, either as regards the instructors or because of disturbances in the ranks of the students, it is impossible to say. In a general way all the classes announced will be started, and most, if not all, of the work will be carried out, even if the numbers attending the classes are seriously diminished. In one or two cases it may not be possible for special instructors to fulfil their engagements.

The courses in the Engineering Day College are to be continued with certain minor adjustments. In the evening classes in engineering the important departures made a year ago by the introduction, as part of the regular courses, of short courses of lectures by specialists in their various subjects, are to be developed. There are minor new developments, too numerous to specify, in all departments, including civil, mechanical and electrical engineering, artistic crafts, technical optics, technical chemistry, etc. Among the special courses are three for pattern-makers, embracing workshop drawing, practical moulding, practical pattern-making, engineering drawing, workshop calculation, etc., and courses for brass and iron moulders, covering workship drawing, workshop calculations, practical moulding, engineering drawing, metallurgy, etc.

MOULDING MACHINES AT THE ATLAS STEEL FOUNDRY.—In the description of the works of the Atlas Steel Foundry and Engineering Company, Limited, Armadale, which we published in our issue of August last, we mentioned that the moulding equipment included two wheel-moulding machines. It may be stated that these machines, which are capable of taking gear wheels up to 10 ft. diameter, were made by Messrs. Wm. Whittaker & Sons, Limited, Sun Iron Works, King Street, Oldham, the well-known wheel-moulding machine specialists. On Whittaker machines gear wheels or pulleys of any description or size from 3 inches upwards in diameter can be made, the larger sizes of machines producing wheels up to 20 ft. in diameter.

Trade Talk.

THE factory of Messrs. Burnwell and Company, brassfounders, of Angelina Street, Birmingham, was severely damaged by fire on September 8.

THE ALBERT DOCK ENGINE WORKS, LIMITED, are being wound up voluntarily, with Mr. T. R. Westray, 138, Leadenhall Street, London, E.C., as liquidator.

THE BOARD OF TRADE has intimated that exports from this country of brass and copper goods will now be allowed, excepting ingots, rods, plates, sheets, etc.

THE ENGINEERS' CLUB, Manchester, has formed a "Pals" battalion for Kitchener's Army, recruited from those engaged in the works and offices of engineering concerns.

THE COUNCIL OF THE WEST OF SCOTLAND IRON AND STEEL INSTITUTE have made donations of £100 to the Prince of Wales National Relief Fund and £50 to the Belgian Relief Fund.

MESSRS. ELLIOT & JEFFREY, of Cardiff, have now taken over the Windsor Slipways and plant, which concern they purchased from Mordey, Carney & Company, Limited, of Cardiff and Newport.

THE partnership heretofore subsisting between J. Schofield and J. Schofield, carrying on business as ironfounders, at Micklehurst, Mossley, under the style of James Schofield & Sons, has been dissolved.

MESSRS. ZEITZ & COMPANY, of 21, Lime Street, London, E.C., and Sheffield, intimate that their firm is British, being entirely owned by British proprietors and carried on exclusively with British capital.

WE understand that the Government have under consideration a scheme for advancing money to business concerns which find themselves in temporary difficulties owing to the disruption of commerce by the war.

THE INTERNATIONAL TRADE EXHIBITIONS, LIMITED, are organising a "London Fair and Market," which will be held at the Royal Agricultural Hall, London, during March/April, 1916. The Exhibition will cover all the trades that are embraced in the Leipzig Fair.

MESSRS. E. A. IRONSIDE and K. J. DYCKERHOFF, carrying on business as merchants and engineers, at 40, Mincing Lane, London, E.C., under the style of Ironside, Son & Dyckerhoff, have dissolved partnership. Mr. Ironside continues the business as Ironside, Son & Company.

MR. EDMUND A. CREED, Royal Chambers, Park Place, Cardiff, informs us that he has opened an office at the above address, where he purposes practising as a consulting, mining and mechanical engineer.

THE order for the 5,000-kw. turbo-generator recently placed by the Bradford Corporation Electricity Committee with a German firm has now been given to the British Westinghouse Electric and Manufacturing Company, Limited.

THE members of the Newcastle and District Branch of the British Foundrymen's Association paid a visit on Saturday, September 26, to the Neptune Engine Works, Low Walker, of Swan, Hunter & Wigham Richardson, Limited.

THE partnership heretofore subsisting between Messrs. J Read, and A. N. Greg, carrying on business as brass stampers and engineers, at Plume Street, Birmingham, under the style of the Planet Stamping Company, has been dissolved.

THE partnership heretofore subsisting between Messrs. H. V. Fox and C. J. Fox, carrying on business as millwrights and engineers, at 65, King's Cross Road, W.C. under the style of C. J. Fox & Sons, has been dissolved. The business will be carried on in the future by Mr. C. J. Fox.

CATALOGUES or price-lists can now be imported duty free into South Africa. This alteration in the law of the Union of South Africa was initiated by the British Electrical and Allied Manufacturers' Association, and effected through the instrumentality of Sir R. Sothern Holland? H.M. Trade Commissioner, Cape Town.

AFTER a stoppage of five months, the whole of the steel works and other departments of the Ebbw Vale Steel, Iron and Coal Company, Limited, have resumed operations; but some difficulty is experienced owing to a shortage of labour due in the main to the large number of regular hands on active service.

THE partnership heretofore subsisting between Messrs. A. J. Jackson and C. B. Westley, carrying on business as engineers, at the Kingswood Engineering Works, Kingswood, under the style of the Kingswood Engineering Works, has been dissolved. The business will be carried on in the future by Mr. A. J. Jackson.

THE partnership heretofore subsisting between Messrs. W. Summerskill and P. Summerskill, carrying on business as machine tool makers, at the Holme Iron Works, Sowerby Bridge, near Halifax, under the style of Summerskill Brothers, has been dissolved. Mr. P. Summerskill will continue the business under the same style.

MR. W. R. TINDALL, formerly connected with the Bristol Engineering Company, informs us that he is now in business as the Eastville Engineering and Rock Drilling Company, at 22, Mivart Street, Eastville, Bristol. The Company's lines of manufactured steel include hammer drills, haulage engines and pumps of various types.

MORE than ten per cent. of the employés of Sir W. H. Bailey & Company, Limited, Albion Works, Salford, Manchester, have enlisted in the Army and the Territorials for active service. The firm is paying 10s. per week to the dependants of each married man, and is also subscribing to a fund which has been created for the benefit of the dependants of the unmarried men by the remaining employés who are subscribing a percentage of their weekly wages.

A supplement to the "London Gazette" has been issued, containing a proclamation authorising the Board of Trade, if they are of the opinion that any article of commerce is being unreasonably withheld from the market, to take possession of any supplies of such article, paying the owner such price as, in default of the agreement, may be decided by the arbitration of a judge.

THE members of the staff and works of the British Thomson-Houston Company, Limited, electrical engineers and manufacturers, are answering the call of their country in a whole-hearted manner. So keen is the patriotism of the employés that up to the present 900 have answered the call from Rugby and the branch works at Willesden and Coventry. The above number represents over 50 per cent. of the eligible male adult employés excluding those above enlisting age, boys under age, and females on the staff and in the works. It is the Company's intention to pay half wages to those of its employés who have enlisted.

MESSRS. G. P. WINCOTT, LIMITED, the well known furnace builders of Sheffield, have been favoured with a repeat order from the Bynea Steel Works, Limited, of Bynea, South Wales, for one 50-ton basic furnace with charging and tapping platform and gas producers, etc. From Messrs. Thos. Firth & Sons, Limited, of Sheffield, Messrs. Wincott, Limited, have secured an order for one large gas-fired bogie annealing furnace, and three 10-cwt. gas producers with flues and chimney. Messrs. Cammell, Laird & Company, Limited, of Sheffield, have favoured the same firm with a repeat order for two re-heating furnaces and one large bogie annealing furnace.

MESSRS. W. & T. AVERY, LIMITED, weighing, testing and computing-machine makers, Soho Foundry, Birmingham, inform us that 165 men from both works and offices have joined the colours, while from the same company's 133 branches throughout the British Isles 69 men are now on active service. All these men's situations are being kept open for them, and the company is making up their military pay and allowances to their full average earnings before the war.

HANS RENOLD, LIMITED, have now announced the policy of the firm towards those who are called up. At a meeting held for the purpose, Mr. Hans Renold urged every young man without ties and family responsibilities to volunteer immediately. Mr. Charles Renold stated that distinctions would be made between employés drawing 50s. per week or less, and those drawing more than 50s. In the former case, full pay would be given to married men for the first four weeks after enlistment, to be followed by half pay until the conclusion of the war. In the event of the man being killed, the allowance would

be continued to his dependents until the end of the war, or until any pension that was available could be obtained. Every man who went would be guaranteed employment on his return. In the case of the men in the receipt of salaries higher than 50s. per week special consideration would have to be given to each case.

THE SHELTON IRON, STEEL AND COAL COMPANY, LIMITED, of Stoke-on-Trent, and Richard John & Nephew, Limited, of the Bradford Iron Works, Bradford, Manchester, have taken up the manufacture of what is known as American "ingot" iron. The right was acquired from the American Rolling Mill Company, of Middletown, Ohio, after exhaustive investigations by the two British firms, particularly as to whether the product could be made in the furnaces at their works. We understand that Dr. Stead has been acting in an advisory capacity. So far as the Shelton Company is concerned, the product has been named "Armco" iron, and the company have no difficulty in making it, having already rolled a considerable quantity into sectional material. The purity of this material is said to be such that it will to a very great extent replace puddled iron.

THE text has been issued of the Bill to authorise His Majesty by Proclamation to suspend temporarily the payment of Bills of Exchange and payments in pursuance of other obligations. The first clause provides that His Majesty may by Proclamation authorise the postponement of the payment of any bill of exchange, or of any negotiable instrument, or any other payment in pursuance of any contract, to such extent, for such time, and subject to such conditions or other provisions as may be specified in the Proclamation. No additional stamp duty will be payable in respect of any instrument as a consequence of any postponement of payment in pursuance of a proclamation under this Act unless the proclamation otherwise directs. The proclamation dated August 3 last, relating to the postponement of payment of certain bills of exchange is confirmed, and will be deemed to have been made under the Act. The Act will remain in force for a period of six months from the date of its passing.

PALMERS SHIPBUILDING AND IRON COMPANY, LIMITED, have formulated a scheme which provides, among other things, for the installation of modern gas engines for blowing the furnaces, and the provision of gas-driven machinery capable of supplying the needs of the company's shipyard, engine works, blast furnaces and steel works, which will enable large volumes of gas to be utilised that are at present going to waste. It is a matter of regret to the directors that the large profits that are being made in other departments are seriously reduced by the loss now being incurred in the iron and steel works. There is a substantial improvement in the trading results for the year ended June 30 last, and although the exact profit cannot yet be stated, it is estimated that after providing for all charges, including interest on debentures and loans the amount will exceed £60,000, as compared with £2,268 for the previous year. In the opinion of the directors, but for the loss in the iron and steel works, the profits for the period mentioned would have been doubled, and therefore they urge that it is absolutely essential that the improvement in the plant and machinery should be effected without further delay. To carry out the scheme will involve an expenditure of about £250,000, which it is proposed to spread over a period of about two years. The work will be put in hand at once and it will be carried out in such a way as to produce progressively beneficial results.

THE BRITISH ALUMINIUM COMPANY, LIMITED, the principal producers of aluminium in Great Britain, have arranged for the release of a considerable number of their staff and employés who have answered the country's call to the colours. Up to the present 453 men—equivalent to 20 per cent. of the company's employés—have joined the forces. At the Kinlochleven, Larne, and Milton Works, and at the head office, the response has been both prompt and enthusiastic, some 40 per cent. of the total employés at Kinlochleven alone having volunteered, which includes practically all those who are eligible. In addition to this, about 200 of the men employed at the company's Milton (North Staffs.) rolling mills are being drilled nightly on the company's premises by their mates who happen to be old soldiers, and both here and at Larne—where the Ulster Volunteers are busy recruiting—more men are joining daily. The places of those who have been called up are being kept open pending their return, temporary provision being made in the meantime by drawing men from industries which are slack during the war, or from those who are otherwise unfit for service. Financial provision is being made for the staff in accordance with their responsibilities, and the families of all married employés serving with the colours, or others dependent upon them, are being paid 10s. weekly, those residing on the company's premises doing so rent free for the present

National Relief Fund.

The following is the second list of subscriptions from the iron, steel, engineering and allied industries to the Prince of Wales' Fund:—

£2,000:—Summerlee Iron Company, Limited.

£1,000 each,—Lochgelly Iron & Coal Company, Limited; Palmers Shipbuilding & Iron Company, Limited; Wallsend Slipway and Engineering Company, Limited; Darlington Forge Company, Limited; Lobnitz & Company, Limited; Fred Lobnitz; W. H. Foster; Wm. Dixon, Limited; Barclay, Curle & Company, Limited; Frodingham Iron and Steel Company, Limited; John Lysaght, Limited; Wm. Lorimer (N.B. Loco. Works); Alex. Stephen & Sons, Limited.

£500 each:—Cargo Fleet Iron Company, Limited, Birmingham Railway Carriage & Wagon Company, Limited; C. A. Parsons & Company; Rivet, Bolt & Nut Company, Limited; Wm. Jacks & Company; Burrell & Son; Sir Thos. Wrightson; Shotts Iron Company, Limited.

£360 each:—John Chamberlain; Arthur Chamberlain.

£300 each:—W. B. Kenrick.

£262 10s. each:—Bullivant & Company, Limited; British Aluminium Company, Limited; Alldays & Onions, Limited.

£250 each:—Delta Metal Company, Limited; Dunsmuir & Jackson; John Lang & Sons; Fleming & Ferguson, Limited; Sir George H. Kenrick; Lloyds British Testing Company, Limited; T. F. Walker; Wm. Tangye; A. T. Keen; Keep Bros., Limited.

£200 each:—Jas. P. Scott; Cockburns, Limited; Samuel, Sons & Benjamin.

£105 each:—P. D. Ridge-Beedle; Drysdale & Company, Limited; Glasgow Steel Roofing Company, Limited; British Welding Company, Limited; New Cransley Iron and Steel Company, Limited; Weldless Steel Tube Company, Limited.

£100 each:—R. Laidlaw & Son (Edinburgh), Limited; David King & Sons; P. & M. Hurll, Limited; Jas. Archdale & Company, Limited; Glasgow Railway Engineering Company, Limited; Alex. Turnbull & Company, Limited; Alex. Turnbull; Ross & Duncan; D. Auld & Sons, Limited; France & Morgan; Hugh Smith & Company, Limited; Blair, Campbell & M'Lean, Limited; Kelvin, Bottomley & Baird, Limited; Jas. Kerr (Etna Iron and Steel Works); Motherwell Bridge Company, Limited; Merriott & Graham; Hydepark Foundry Company, Limited; Craig & Donald, Limited; Loudon Brothers, Limited; W. H. Hustler; Cyrus Braby; Dixon & Corbitt & R. S. Newall & Company, Limited; Hurst, Nelson & Company, Limited; A. G. Brown, Limited; J. Macdonald & Son, Limited; A. & P. Steven; Penman & Company, Limited.

£60:—Geo. Christie, Limited.

£52 10s. each:—W. Cochran Carr; Catton & Company, Limited.

£50 each:—T. Boston & Son, Limited; W. H. Arnott, Young & Company; Morris, Warden & Company, Limited; Hunter & Jack; Gowanbank Foundry Company; D. Bennie & Sons, Limited; J. Stewart & Company (Glasgow), Limited; Carrick & Wardale; Haggie Brothers; J. & J. Ingham & Company, Limited; Maj. H. S. Streatfeild; Edwin Handley & Sons.

Deaths.

THE death is announced of Mr. J. Rawlinson, iron broker, of Moorside, Swinton, Lancs.

MR. W. F. POOL, who founded the business of Pool, Skinner & Williams, Dock Head Foundry, Falmouth, died recently at the age of 84 years.

THE death is reported of Mr. A. Wadsworth, a director of W. Wadsworth & Sons, Limited, engineers, Thynne Street Works, Bolton, Lancs. The deceased gentleman was only 47 years of age.

MR. G. PEARCE, a director of Williams, Harvey & Company, Limited, tin smelters and merchants, of the Mellanear Works, Bootle, Liverpool, and the Mellanear Tin Works, Hayle, Cornwall, died recently.

MR. J. H. PAGE, consulting engineer, of African House, Water Street, Liverpool, died at his residence, "Sandhurst," Formby, recently. The deceased gentleman served his time with Messrs. Fawcett, Preston & Company, engineers, of Liverpool.

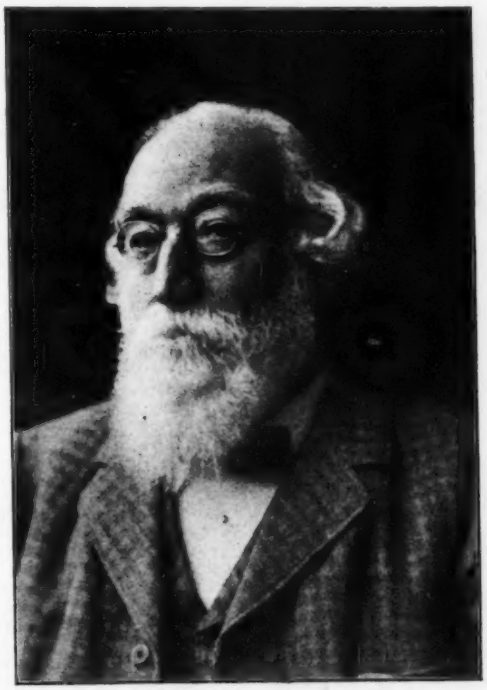
THE death occurred at his residence, Green Bank, Hylton, on September 5, of Mr. Arthur Doxford, son of Mr. Robert Doxford, and a member of the firm of Messrs. W. Doxford & Sons, shipbuilders, Pallion, Sunderland. Mr. Doxford, who was 34 years of age, had been in failing health for several months. He was actively identified with Messrs. Doxford's business, and esteemed by all with whom he came into contact. The deceased was a nephew of Sir Theodore Doxford.

THE death has occurred at Llewe'dene, near Douglas, Cape Colony, as the result of an accident, of Mr. E. Allen Nicholls. Mr. Nicholls matriculated at London, and obtained his Bachelor of Science degree, with first-class honours, when about twenty years of age. He was engaged at the St. Andrews University, St. Andrews, Scotland, as an analytical and metallurgical chemist, and then took up the duties of a supervising engineer.

THE death is announced of Mr. Alfred Dowson, who was at one time a well-known civil engineer, with offices in Westminster, London, S.W. His principal work laid in the direction of the construction of harbours, piers, etc., both in this country and abroad. Subsequently he joined the Dowson Economic Gas-Power Company as engineer, which company was formed by his brother, Mr. J. E. Dowson. He then became general manager of the works, and held that position up to the time of his retirement in 1908.

We regret to announce the death, as the result of a tragic accident while on a holiday at Broadstairs, of Sir Stephen Wilson Furness, Bart., M.P. for the West Hartlepools. The deceased, who was the first baronet, was a nephew of the late Lord Furness, who, as Sir Christopher Furness, was his predecessor in the representation of the Hartlepools. The news of his untimely death at the age of 42 years has been received in commercial circles with most profound regret, he being held in the greatest personal respect and esteem. At the inquest, which was held at Broadstairs on September 7, a verdict of "Accidental death" was returned. Sir Stephen was the eldest son of the late Mr. Stephen Furness, of Berwick St. James, Wiltshire, and a nephew of the late Lord Furness, whom he succeeded as representative of the Hartlepools in June, 1910. He was born on May 20, 1872, and received the greater part of his education at Ashville College, Harrogate. After leaving school he entered business life under the guidance of his late uncle, then Sir Christopher Furness, at West Hartlepool, and there ever-growing facilities helped him to develop his latent capacity for industrial organisation. Since the late peer's death he had assumed the leadership of many of the industrial undertakings with which his lordship was associated, becoming chairman of Furness, Withy & Company, Limited, the Irvine's Shipbuilding and Dry Docks Company, Limited, South Durham Steel and Iron Company, Limited, and Geo. V. Turnbull & Company. He was vice-chairman of Richardsons, Westgarth & Company, Limited, and the Weardale Steel, Coal and Coke Company, Limited, and a director of the Cargo Fleet Iron Company, Limited, and the Northumberland Shipbuilding Company, Limited.

WE greatly regret to announce the death of Mr. Edward Riley, whose name has been identified so closely and so honourably with the iron and steel industry for many years. Mr. Riley, who was born in 1831, was educated at King's College School, London, and at the Putney Civil Engineering College, which has long ceased to exist. He then became a student under Dr. Lyon Playfair (afterwards Lord Playfair) at the Laboratory of the Board of Health, and afterwards became his assistant at the laboratory in Jermyn Street, where he remained till 1853, when, on the recommendation of Sir Henry de la Beche, President of the Geological Survey of England, he was appointed chemist to the Dowlais Iron Works in South Wales. Mr. Edward Riley was intimately associated with the early experiments on the Bessemer process. In 1859 Mr. Riley resigned his position at Dowlais and



THE LATE MR. EDWARD RILEY.

started in private practice as a consulting and analytical chemist in London, and Sir Henry Bessemer, recognising his ability, sent to him the greater part of the analytical work required in connection with his process. He also at this time carried on a very exhaustive investigation into the titaniferous iron-ore deposits of Norway. For two or three years Mr. Riley resided at Leeds, experimenting with titaniferous ores and practising as an analytical chemist, but finally the experiments were abandoned. During his residence in Leeds he married, and soon afterwards returned to London and continued his practice at Kensington, still doing the greater part of Bessemer's work, and in 1869 he removed his laboratory to Finsbury Square, where the firm, under the style of Edward Riley & Harbord, still continue to practice as consulting metallurgists and analytical chemists. With the development of the Bessemer process came the necessity for spiegel and ferro-manganese, and Mr. Riley was associated with Henderson in carrying out the analyses in connection with his process for producing "ferro" in the open-hearth furnace. This brought him into contact with importers and users of manganese ores,

and by his reputation for accurate work he soon became the acknowledged authority on questions in dispute regarding the analyses of these and similar ores. In the early eighties he commenced experiments on basic linings, and, as a result, took out a patent for the use of crude petroleum oil and tar as a binder for use with burnt lime or dolomite. This was found so satisfactory that Mr. Riley conveyed his patent to the proprietors of the basic process for a share in the basic patents, and in this way became intimately associated with the basic or Thomas-Gilchrist process. Eventually, in conjunction with others, he started the North-Eastern Steel Company and Messrs. Hickman, Limited, and became a director of both companies. In the early fifties accurate methods of analysis in connection with both the raw materials and finished products from iron and steel works were almost unknown, and Mr. Riley was one of the pioneers in devising and perfecting methods for accurate determinations. He read many papers before the Chemical Society and the Iron and Steel Institute, embodying methods of analysis, and although some have been modified as experience has been gained, many of them are still accepted as standard, and the iron and steel industry owes a great debt to the untiring and careful work of Mr. Riley and those who worked with him in these early years. Mr. Riley, although 83 years old, was still in enjoyment of all his faculties and with memory unimpaired up to the close of his long and useful career, and although unable to take any active part in professional work, still followed technical matters with the keenest interest. As recently as May last he was presented with the Bessemer Gold Medal at the meeting of the Iron and Steel Institute, his partner, Mr. Harbord, receiving it on his behalf. Mr. Riley had resided at Marlow, on the River Thames, for twenty-six years, and took the keenest interest in all matters connected with the welfare of the town. The funeral of the late Mr. Riley took place at Bisham (Berks.) on September 15, in the presence of a large and representative gathering.

MOTOR WAGONS FOR FUEL OIL DELIVERY.—The enterprise of the Anglo-Mexican Petroleum Products Company, Limited, Finsbury Court, London, E.C., is evidenced in the new fleet of steam motor tank wagons which has recently been inaugurated for delivering Mexican fuel oil throughout the country. These tank wagons and their trailers have a capacity of about four tons each, and are fitted with steam-heating coils to facilitate delivery in cold weather, and are equipped with steam pumps, which discharge the contents in minimum time. The wagon and trailer (when attached) are fitted with steel-tyred wheels; others of the fleet which work without the trailer are fitted with the familiar rubber lorry tyres, and are able to quickly cover long distances in making deliveries. Some of these motor wagons are already in service in London, Leeds, Manchester, and Birmingham, and the requirements of other centres of distribution are being met as promptly as possible. The introduction of these vehicles marks yet another step in the progress of oil fuel for numerous industrial purposes.

THE JUNIOR INSTITUTION OF ENGINEERS.—The Council of the above Institution have elected The Most Hon. the Marquess of Graham, D.L., C.B., C.V.O., as their President for the year 1914—1915, in succession to Sir Boverton Redwood, Bart., D.Sc., F.R.S.E. The Vickers Prize consisting of a Gold Medal and premium of instruments or books, has been awarded to Mr. James Richardson, B.Sc., Assoc.Inst.C.E. for his Paper on "High Power Diesel Engines; their development for Marine Service." Mr. Richardson has also been fortunate enough in securing the Institution Medal for the same Paper. The other awards of this Institution have not yet been announced. It is interesting to note the excellent progress made with the local Sections in Birmingham, Manchester and Sheffield. The membership has been considerably increased during the year.

Personal.

Mr. F. Gilbertson has been re-elected president of the Swansea Royal Metal Exchange for the ensuing year.

The late Mr. J. E. Taylor, of Messrs. Taylor Bros., brassfounders, Birmingham, left net personalty valued at £12,920.

Mr. G. Richardson and Mr. J. Kerr have retired from the board of the United Electric Car Company, Limited, Preston.

The late Mr. H. J. Wilson, of Sheffield, a director of the Sheffield Smelting Company, Limited, left estate valued at £49,049.

The gross value of the estate of the late Mr. G. J. C. Dawson, engineer to the North Staffordshire Railway Company, is £20.015.

Sir William Beardmore, Bt., chairman of William Beardmore & Company, Limited, has been elected a director of the Star Assurance Society.

Lord Furness has been elected chairman of Irvine's Shipbuilding and Dry Docks Company, Limited, in succession to the late Sir Stephen W. Furness, Bart.

The late Mr. R. B. Longridge, of Yew Tree, Tabley, Cheshire, chairman of the British Engine Boiler and Electrical Insurance Company, Limited, left £89,960 gross.

Mr. E. W. Scotson, the assistant manager of the Alfreton Ironworks, has been the recipient of a presentation from the staff and officials upon the occasion of his recent marriage.

Mr. W. B. Pickering, the commercial manager of Hadfields, Limited, East Hecla Works, Tinsley, Sheffield, who has been with the company for 23 years, has been elected a director of the company.

Mr. C. Koettgen has resigned his position as director and managing director of Siemens Brothers Dynamo Works, Limited, and has no further connection with the company.

Mr. M. Thomlinson has been the recipient of a presentation on his retirement from the position of general manager to the Hull Forge Iron and Steel Company, Limited. Mr. Thomlinson continues a director of the Company.

Mr. Walter W. Storr has resigned his position, after 24 years' service, at first as secretary, and latterly as general superintendent, of Messrs. Bolckow, Vaughan & Company, Limited, and has been elected to a seat on the board.

Mr. Charles Stafford Schultz, a director of Messrs. Dick, Kerr & Company, Limited, who is a British subject born at Ingersol, Ontario, has renounced the surname of Schultz, and adopted the name of Charles Stafford Stafford.

M. Adolphe Greiner, general director of the works of the Société Anonyme John Cockerill, of Seraing, near Liége, and President of the Iron and Steel Institute, is reported to have been set free by the Germans. After the fall of Liége the invaders placed M. Greiner under arrest because he refused to run the works on behalf of the German military authorities.

Mr. H. A. Butz, for the past four years chief engineer of the Dominion Iron and Steel Company, Limited, Sydney, Nova Scotia, Canada, has severed that connection owing to the Company discontinuing for an indefinite period all construction work, due to the present war conditions. Mr. Butz was formerly with the Garrett Cromwell Engineering Company, of Cleveland, Ohio, U.S.A.

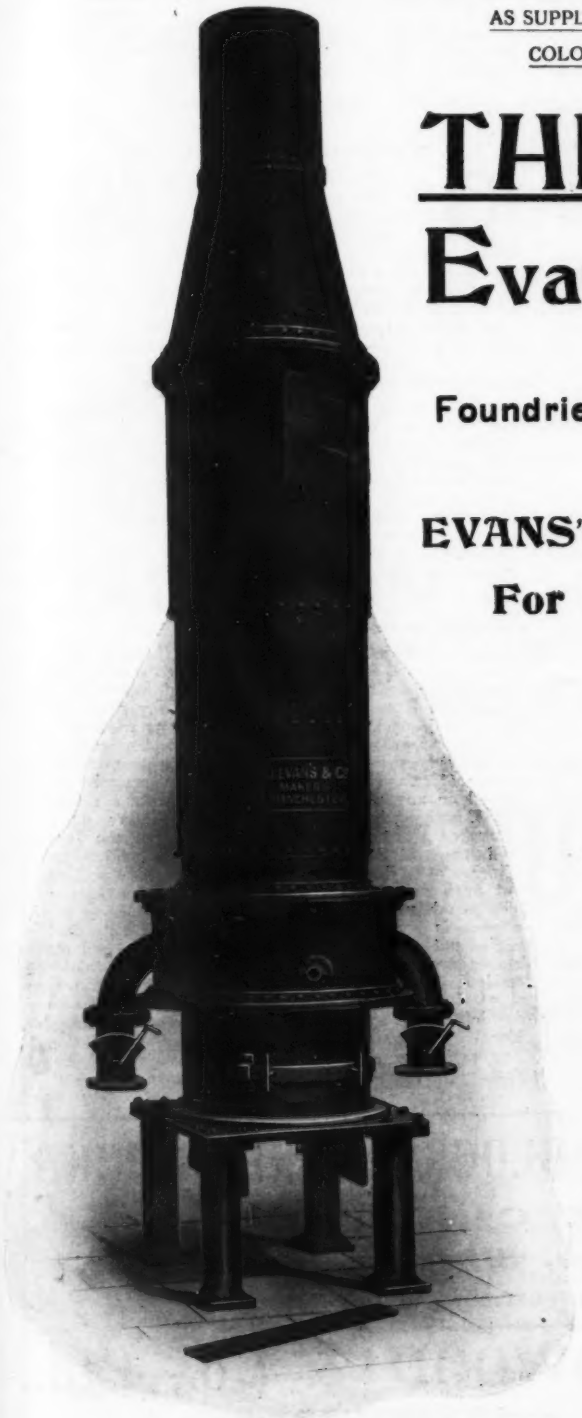
Mr. S. G. Smith (foundry manager) was the guest at a farewell gathering last month at Messrs. Cole, Marchent & Morley's Hammerton Street Foundry, Bradford, when he was presented with a Gladstone bag and a silver-mounted briar pipe on the occasion of his departure to take up an important post as assistant foundry superintendent for the British Westinghouse Company, Limited, Trafford Park, Manchester. The foreman (Mr. Parker) presided, and in turn the staff, moulders' apprentices, and labourers voiced their feeling of respect and admiration for Mr. Smith, wishing him every success in his new sphere. Mr. Smith suitably responded, and thanked all who had subscribed to the gift.

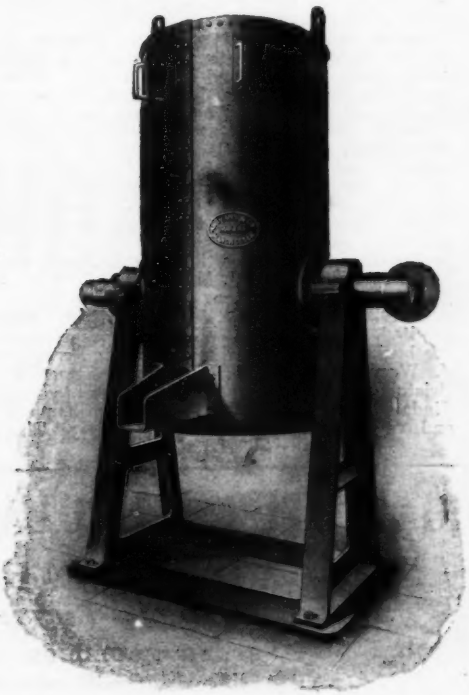
AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.

THE Cupola.
Evans's Rapid.

Foundries Completely Furnished.

EVANS'S NEW CUPOLETTE
For Emergency Work.





James Evans & Co.,
Britannia Works,
Blackfriars,
MANCHESTER.

Telegrams: "LADLES, MANCHESTER."
Telephone: 2297 CENTRAL, MANCHESTER.

New Companies

Thomas Gregory & Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of ironfounders, etc.

United Machine Tool Company, Limited.—Capital £2,000 in £1 shares. Registered office:—Hop Exchange Buildings, 24, Southwark Street, London, S.E.

Davis & Primrose, Limited.—Capital £10,000 in £1 shares, to acquire and carry on the existing business of ironfounders, etc. Registered office: 9, Bangor Road, Leith.

Grimsby & Company (Leicester), Limited.—Capital £2,000 in £1 shares (500 5½ per cent. cumulative preference), to carry on the business of engineers. Registered office: Queen Street, Leicester.

Alfred Partner & Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of iron, brass and metal workers. Registered office:—812a, Old Ford Road, Bow Bridge, London, E.

Thermotic Appliances, Limited.—Capital £2,000 (1,900 £1 ordinary shares and 2,000 1s. deferred) to carry on the business of mechanical engineers, founders, etc., and to adopt an agreement with A. C. Weller.

Luton Iron Foundry Company, Limited.—Capital £1,750 in 1,000 £1 6 per cent. preference shares and 15,000 ordinary shares of 1s., to acquire the business of the Luton Iron Foundry Company. Registered office: 110 Cannon Street, London, E.C.

Utile Engineering Company, Limited.—Capital £1,000 in £1 shares, to take over the business of engineers formerly carried on by S. R. Fish, Wellingborough, as the British Utile Speciality Company, and by S. J. Poole and S. Poole, at Irthlingborough.

James Mackrell & Company, Limited.—Capital £12,000 in £1 shares, to take over the business of millwrights, engineers and iron and brass founders at the Union Foundry, Elland. The first directors are L. Mackrell, H. Mackrell, W. Crosland and D. Drake.

United Kingdom Manufacturers' Representatives Association, Limited.—Capital £10,000 in £1 shares (5,000 6 per cent. participating preferred), to carry on the business of providing manufacturers' representatives and agents in all parts of the world, merchants, traders, etc., and to bring to bear diplomatic and other pressure with regard to tariff restrictions and infringements under the Merchandise Marks Act. The first directors are J. Molenkamp, C. T. B. Jayne, G. Prosser and C. Burton.

Eastville Engineering & Rock Drill Company, Limited.—Capital £2,000 in £1 shares to take over the business of a general engineer, etc., carried on by J. Woodman, at 22 & 23, Mivart Street, Easton, Bristol; and also to acquire patents granted to W. R. Tindall for improvements in percussive hammer drills and valves for percussive rock drills. The first directors are F. A. Hunt (chairman), W. R. Tindall and F. G. Tricks (all permanent). J. Woodman is general engineer and W. R. Tindall working manager. Secretary: F. G. Tricks, 18, St. Nicholas Street Bristol.

Parliamentary Notes.

Patents Bill.

This Bill has been read a third time in the House of Commons. Mr. Runciman has made it clear that enemy patents are not cancelled but only suspended during the war, the royalties to go to the Government. If, after the war, Germany or Austria-Hungary taxes or confiscates British patents we shall do the same with their patents in the United Kingdom. But if they agree to keep our patents alive, we shall respond.

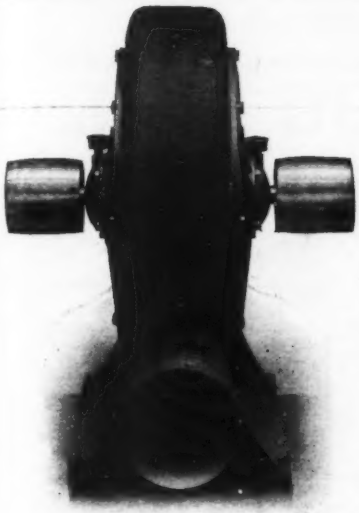
Government Control of Railways.

Questioned in the Lower House on the subject of the railways, MR. RUNCIMAN has indicated that no payments are being made to the railways at present. The individual companies retain the management of their lines subject to instructions issued by the Executive Committee. The companies had issued a notice disclaiming responsibility for delay, damage, or loss due to curtailment or interruption of train services in consequence of the war. Any claims for delay, damage, or loss attributable to other causes would be dealt with as usual.

Compulsory Declaration of Stocks.

The text has just been issued of the Bill to give powers in connection with the present war to obtain information as to stocks of articles of commerce, and for enabling possession to be taken of any such articles unreasonably withheld. The first clause provides that for the purpose of obtaining information as to the quantity in the United Kingdom or in transit of any article of commerce, the Board of Trade may by notice served on any person require him to make a return to the Board giving such particulars of any article of commerce of which he is the owner. For the purpose of testing the accuracy of any return, any authorised officer of the Board may enter any premises and carry out such examinations as he may consider necessary. The penalties are a fine not exceeding £100, or if the offence is committed wilfully, imprisonment for a period not exceeding three months. The second clause makes provision for the Board of Trade to take possession of any supplies considered as being unreasonably withheld from the market at such price as may, in default of agreement, be decided to be reasonable. For the purposes of this Act "owner," in relation to any article of commerce, includes any person who, as factor or otherwise, has power to sell the article.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."



TRADE SIROCCO MARK

CUPOLA FANS.

Made in eight sizes from 10-in. to 35-in. diameter, and suitable for melting ½ to 20 tons per hour at pressures from 12—30 inches Watergauge.

Cast Iron Casings and Ball Bearings.

Double Inlet. All Types of Discharge.

Write for Bulletin No. 2028F.

DAVIDSON & CO., LIMITED,

Sirocco Engineering Works,

BELFAST.

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE BRITISH ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Collieries, Ltd., Cardiff.

Telegraph: ELDER, CARDIFF. **Telephone: 4640 and 4641.**

MONTHLY PRICE LIST.

The undermentioned prices, unless otherwise specified, are those obtaining on the first day of the current month.

Pig-Iron.

Cleveland.

	s.	d.
Cleveland No. 1	53	9
,, No. 3	51	3
,, No. 4 foundry	51	0
,, No. 4 forge	50	9
,, Mottled	50	3
,, White	50	3
East Coast hematite, mixed Nos. ..	70	0
Cleveland warrants	51	2

Above prices are for early f.o.b. deliveries, and as regards Cleveland iron are for G.M.B. brands. The warrant quotations are the sellers cash prices.

Scotland.

	s.	d.
Standard Foundry (Glasgow Market settlement price)	50	7½
Warrants, ditto	57	0

Makers' prices:—	s.	d.		s.	d.
Gartsherrie No. 1..	70	0	No. 3..	65	0
Coltness No. 1..	70	0	No 3..	70	0
Summerlee No. 1..	70	6	No. 3..	65	6
Langloan No. 1..	72	0	No. 3..	67	0
Calder No. 1..	70	0	No. 3..	65	0
Clyde No. 1..	70	0	No. 3..	65	0
Carnbroe No. 1..	68	0	No. 3..	64	0
Monkland No. 1..	65	0	No. 3..	64	0
Shotts No. 1..	71	0	No. 3..	65	0
(All deliverable alongside Glasgow.)					
Glengarnock No. 1 .	71	0	No. 3..	66	0
Eglinton No. 1..	64	0	No. 3..	63	0
(All deliverable alongside Ardrossan.)					
Dalmellington No. 1	67	0	No. 3..	65	0
(Deliverable alongside Ayr.)					
Carron No. 1..	70	6	No. 3..	65	6
(F.a.s. Grangemouth.)					

Lancashire.

	s.	d.	s.	d.
Lancashire No. 3 foundry f.o.t.	—		—	
Lincolnshire No. 3 foundry ..	—		60	0
Derbyshire No. 3 foundry ..	—		61	0
Staffordshire No. 3 foundry ..	—		61	0
Cleveland No. 3 foundry ..	—		60	6
(All delivered equal Manchester.)				
Scotch No. 3 — Gartsherrie	—		69	0
Glengarnock	—		67	6
Eglinton	—		66	0
Summerlee	—		69	0
(Delivered Manchester Docks.)				

North-West of England.

	s.	d.	s.	d.
Bessemer mixed numbers net f.o.b.	74	6	75	6
Hematite warrant net cash ..	—		66	0
Lorn cold-blast charcoal iron ..	180	0	190	0

The Midlands.

	s.	d.	s.	d.
Staffs. — Common forge ..	59	0	60	0
Part Mine forge ..	60	0	61	0
Best All Mine ..	—		90	0
Cold Blast	—		130	0

Strong forge, about 1s. less than grey forge; Mottled and White, about 2s. less than forge; Foundry No. 3, 3s. to 5s. above forge; No. 1 and No. 2, from 1s. 6d. to 2s. above No. 3; No. 1, about 2s. above No. 2.

Northampton foundry	—	—
North Staffs. foundry	—	—
Derby foundry	—	—
Nottinghamshire foundry ..	—	—
Leicestershire foundry	—	—
Shropshire Cold-Blast	—	—

(Delivered South Staffordshire Works, net cash monthly.)

Lincolnshire.

	s.	d.	s.	d.
Forge	—		—	
Grey forge..	—		—	
Basic	—		—	
No. 3 foundry	—		—	
No. 4 foundry	—		—	
F.o.t. Makers' works.				

South Wales.

	s.	d.	s.	d.
Welsh Hematite	75		76	6

Ferro-Alloys.

Net, Delivered Sheffield Steel works.

	£	s.	d.	£	s.	d.
Ferro-chrome: 4/6% carbon. Basis 60%, scale 10s. per unit. Per ton				—		
Ferro-chrome: 6/8% carbon. Basis 60%, scale 10s. per unit. Per ton				—		
Ferro-chrome: 8/10% carbon. Basis 60%, scale 8s. 6d. per unit. Per ton				—		
Ferro-chrome: Specially refined, guaranteed maximum 2% carbon, broken to small pieces for use in best quality crucible steels. Basis 60%, scale 22s. per unit. Per ton				—		
Ferro-vanadium: 33/40% Va., per lb. of Va. contained in the alloy ..				—		
Ferro-silicon: 45/50%. Basis 50%, 5s. scale per unit .. Per ton				—		
Ferro-titanium: 15/18%, per pound, flat				—		
Ferro-molybdenum: 70/80% Mo. per pound of Mo. contained				—		
Ferro-phosphorus: 20/25%. Per ton				—		
*Ferro-manganese 80%	12	10	0			
,, export				—		

* F.o.b. Liverpool.

Iron Castings.

Cleveland.

	£	s.	d.	£	s.	d.
Columns (plain)	7	7	6 to	7	12	6
Pipes, 1½ to 2½ in. ..	6	7	6	6	12	6
,, 3 to 4 in. ..	5	17	6	6	0	0
,, 5 to 8 in. ..	5	12	6	5	15	0
,, 10 to 16 in. ..	5	15	0	—		
,, 18 to 24 in. ..	5	15	0	—		
Chairs	4	5	0	4	6	0
Floor plates (open sand)	3	10	0	3	12	6
(At works.)						

Non-Ferrous Metals.

Copper.

	£	s.	d.
Standard, Cash	—		
Three months	—		
Electrolytic	54	12	6
Tough	58	0	0
Best selected 57 10 0	58	0	0

Tin.

Standard, Cash	—		
,, Three months ..	—		
English Ingots	135	15	0
Bars	176	15	0
Refined	—		

Spelter.

Silesian	24	15	0
Specials	—		
Hard	21	10	0
British	28	10	0

Lead.

Soft foreign	19	10	0
English	19	15	0

Antimony.

Regulus .. .. —	—

Aluminium.

Virgin Metal, 98/99% .. per ton.	—

*Chromium (Metallic).

98/99% purity per lb. ..	—

*Nickel.

In cubes, 98/99% purity Per ton	—

*Tungsten Metal Powder.

96/98% purity .. .. per lb.	—

*Molybdenum Metal.

96/98% purity.. per lb. 10s. 6d. to	—

*Cobalt Metal.

97% purity .. per lb. 6s. 9d. to	—

Quicksilver.

75 lb. bottle	7 1 3

* Net, Delivered Sheffield Works.

Scrap Iron and Steel.

Cleveland.

	s.	d.		s.	d.
Steel scrap, heavy melting ..	49	0	to	51	0
Iron scrap cast (cupola metal)	52	6		55	6

London (f.o.b.).

Heavy steel	50	0	
Light ,, ...	35	0	
Heavy cast	50	0	

Non-Ferrous Scrap.

London merchants quote, delivery free, and subject to market fluctuations:—

	J. B. Garnham and Sons. £ s. d.	A. Joseph. £ s. d.
Brass	—	—
Clean copper	—	—
Brazlery copper ..	—	—
Old lead	—	—
Tea lead	—	—
Old zinc	—	—
Hollow pewter ..	—	—
Black pewter (shaped)	—	—
Gun metal	—	—
Aluminium (cuttings)	—	—

Stocks.

Pig-Iron in Public Store.

	Aug. 27. Tons.	Inc. + or Dec. — since Aug. 28 1913. Tons.
Connal's at Glasgow Scotch ..	1,000	No change.
Ditto other makes ..	2	— 18
Connal's at Middlesbrough	100,353	— 73,388
Connal's at Middlesbrough, hematite ..	—	No change.
West Coast hematite..	3,058	— 14,662

Metals.

Copper, Europe and afloat	—	—
Tin, London, Holland, U.S.A. and afloat	—	—

Coke.

Middlesbrough.

	s.	d.	s.	d.
Gas Coke	—		13	0
Foundry Coke ..	20	6	to 23	0
Furnace coke	—		18	0

Newcastle-on-Tyne.

	F.o.b. Dunston. s.	d.
FOUNDRY COKE—		
Original Garesfield	21	6
Mickley	21	0
Stella Garesfield	21	6
Priestman's Garesfield	22	6
Consett Garesfield	21	6
Newcastle gas coke	12	6

Cardiff.

	s.	d.		s.	d.
Special foundry coke ..	28	0	to 30	0	
Foundry coke	22	0	to 25	0	
Furnace coke	18	0	to 20		

Leeds.

Furnace coke (washed) ..		1	6

Birmingham.

Foundry coke	—					
Furnace ,, ...	17	0	to	19		
Gas ,, ...	—					

Glasgow.

Foundry coke	—
Furnace ,, ...	—
Gas ,, ...	—

London.

Foundry coke	—
Gas ,, ...	—

Established 1863.

JAS. DURRANS & SONS,

Phœnix Works, Penistone, Near Sheffield.

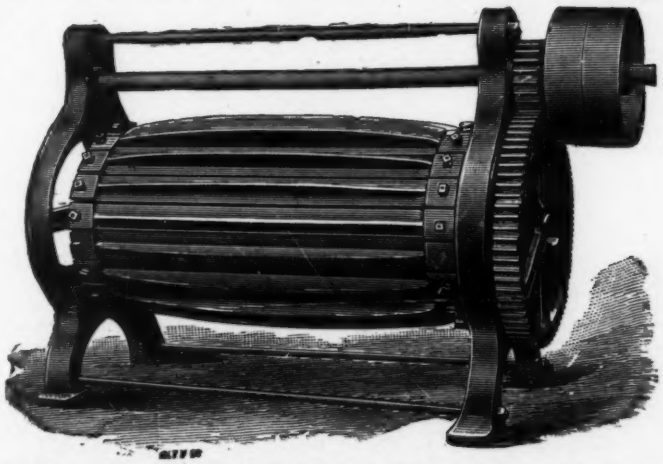
Manufacturers of all

FOUNDRY EQUIPMENTS

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

Improved Foundry Rattler or Fettling Drum.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

The following testimonial explains itself :—

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD.

Patent Sand Mixer

Uses up more old sand than has hitherto been considered possible.

Our Patent Sand Mixer has the following desirable advantages.

The sand is thoroughly aerated, rendered light and loose in texture and of even temper.

Previous milling of the sand is unnecessary.

Seven hundredweights of sand dealt with per minute.

All bearings are ball bearings.

All gears are casehardened steel.

All gears and bearings run in an oil-bath rendering them practically everlasting.

Cages easily examined and cleaned.

Cages do not clog as there are no curved passages.

Machines can be seen in operation in our foundries, Edgwick, Coventry.

ALFRED HERBERT, Limited,

Coventry.

SITUATIONS VACANT AND WANTED.

A FOREMAN is required to take entire charge of Iron Foundry. Must be a good Manager, thoroughly experienced in producing Castings for high-speed Steam Engines, Air Compressors, etc.—Apply, giving full particulars of experience, to PETER BROTHERHOOD, LTD., Peterborough.

FOUNDRY FOREMAN, age 35, desires change. Expert metal mixer, tensile tests, 11 tons. Ratio coke to iron, 1 to 10. Abstainer, up-to-date, disciplinarian. —Box 536, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

WANTED, a Man thoroughly conversant with the working of a Side-blown Converter Plant of the "Stock" Patent Oil fired type, capable of taking entire responsibility for the Steel made and of making his own analyses. Preferably a bachelor. Willing to go to Australia on a year's agreement. Second-class passage paid. Reasonable salary for good man. Applicants must, however, state the salary that they expect.—Apply JOHN BIRCH & COMPANY, LIMITED, 2, London Wall Buildings, London, E.C.

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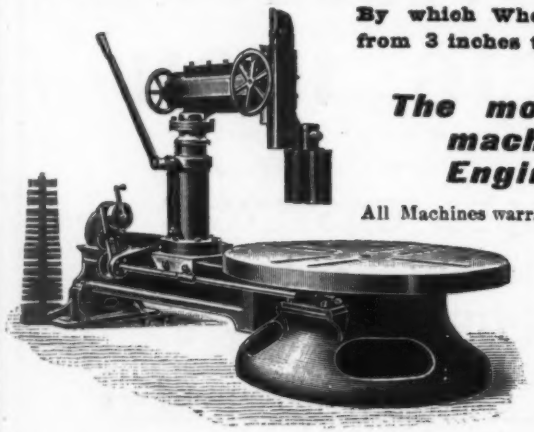

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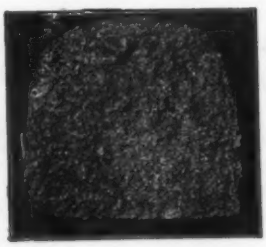
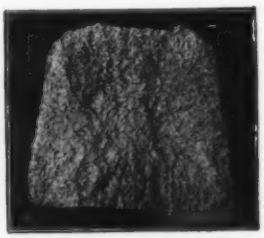
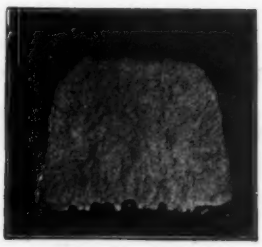

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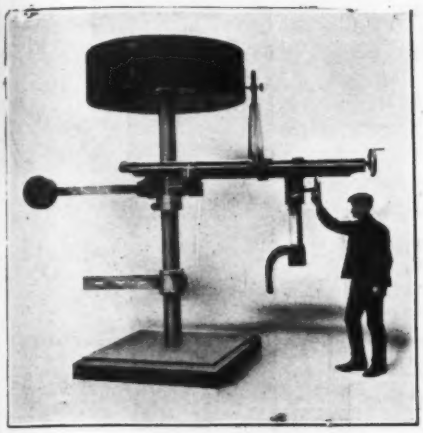

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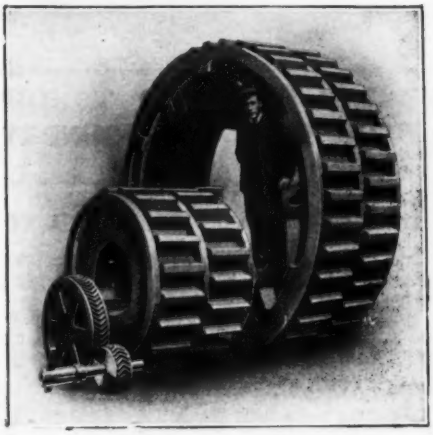

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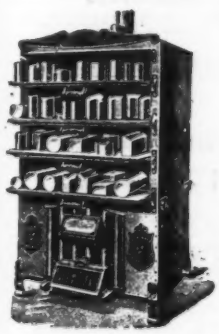

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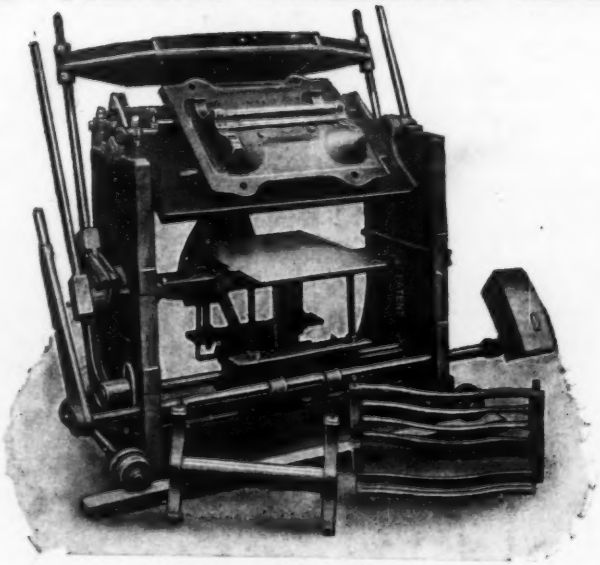

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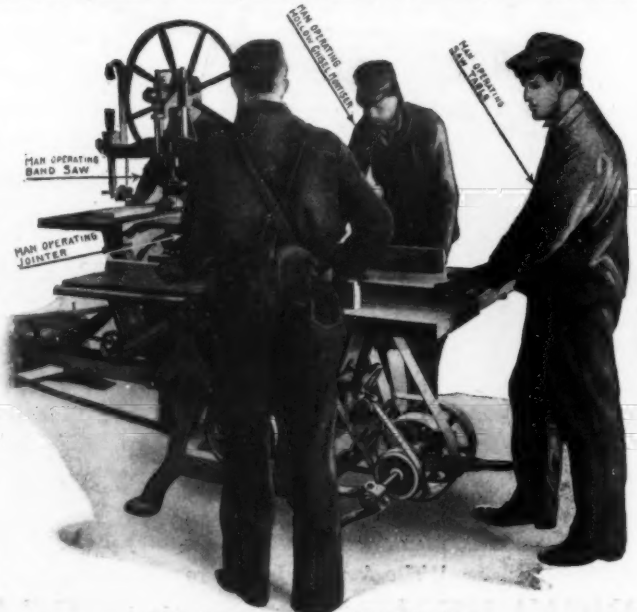

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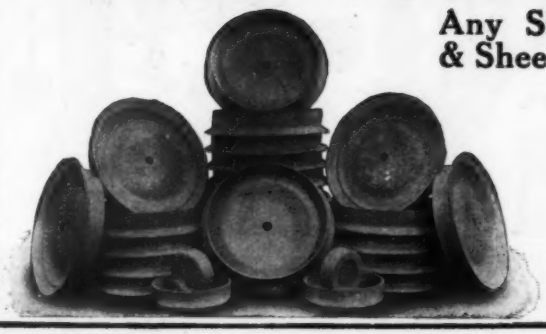

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